YUROK TRIBE

Watershed Restoration Department

1998 MCGARVEY/AHPAH WATERSHED RESTORATION TRAINING AND IMPLEMENTATION REPORT

by: Dee Randolph, Steve Namitz, Jim Bond, & Joe James

1998 McGARVEY/AH PAH WATERSHED RESTORATION TRAINING AND IMPLEMENTATION PROGRAM

EXECUTIVE SUMMARY

The purpose of this report is to summarize the restoration work completed by the Yurok Tribe, as part of the Lower Klamath Restoration Partnership's 1998 projects.

From June through October, 1998, the Yurok Tribe conducted a Watershed Restoration Training and Implementation Program within the McGarvey and Ah Pah Creek drainage basins. This was the initial phase of a multi-year restoration effort, which is intended to remediate man-caused sediment sources from 30 tributary sub-basins, within the Lower Klamath River Basin.

This program was part of long-term watershed restoration goals intended to fulfill two principal Tribal objectives:

1. To return the Klamath River fisheries to their healthiest possible condition.
2. Jobs training and employment opportunities for Tribal members.

The McGarvey/Ah Pah Watershed Training and Implementation Program employed 18 Tribal members, and provided them with the technical skills needed for watershed restoration work within the Tribal Fisheries' Restoration Division. The program lasted 18 weeks, and was divided into 2 phases, including:

1. a 6-week "classroom" on the basic concepts and methodologies currently used by watershed restoration technologists. This "classroom" was located at a training center on a specially selected landing, in the McGarvey Creek watershed, which modeled several of the problems encountered by watershed restorationists.

2. a 12-week training/implementation phase, using hands-on field experience to teach the techniques utilized by ground personnel and heavy equipment operators. This training included actual implementation of the hydrologic decommissioning along prioritized roads within the McGarvey and Ah Pah Creek watersheds.

Hydrologically decommissioned roads included all (or portions of) MacGarvey watershed's M-1000, M-800, M-805, M-810, M-820, M-830, M-400, the Old M-10, and Ah Pah watershed's B-1100 and B-1070 roads. In the McGarvey Creek watershed, approximately 6.3 miles of roads were hydrologically decommissioned, preventing an estimated 68,401 yd^3 of road fill material from entering surrounding streams. Figures for the Ah Pah Creek watershed include 4.7 miles of roads for 12,799 yd^3 of fill saved from entering the streams. This gives a grand total of 11 miles of decommissioned roads, and 81,200 yd^3 of road fill material saved, by the entire project.

Table of Contents

EXECUTIVE SUMMARY....i

Table of Contents....ii

List of Tables....iv

List of Figures....iv

INTRODUCTION....1
- Location....1
- Land Status....3
- Fisheries Background....3

LAND USE HISTORY....3
- Tribal Use....3
- Fishing....4
- Timber Harvesting....4
- Tourism....4

PRIORITIZATION OF THE LOWER KLAMATH WATERSHED....4
- Long Range Planning....5

PHYSIOGRAPHY OF THE WATERSHEDS....11
- Geology....11
- McGarvey Creek Watershed....11
- Ah Pah Creek Watershed....11

PRIORITIZATION OF WORK SITES....12

TRAINING PROJECT....12
- Introduction....12
- Training Approach....12
- Training Site Location....13
- Training....13
  - Ground Personnel....13
  - Heavy Equipment Operators....13
- Post-Training....14

GENERAL METHODOLOGY....14
- Step #1: Air Photo Analysis....14
- Step #2: Road Primary Line Survey....14
- Step #3: Geomorphic Mapping....14
- Step #4: Site Prescription and Layout....15

Step #5: Implementation....16
Step #6: Post-Work Site Survey....19
Step #7: Effectiveness Monitoring....19

PROJECT IMPLEMENTATION....20
Work Priority....20
McGarvey Creek....20
Ah Pah Creek....20

McGARVEY CREEK WATERSHED....23
Roads Worked....23
M-1000....23
M-800 + Spurs:....23
M-800....25
M-805....25
M-810....25
M-820....25
M-830....26
M-400....26
Old M-10:....26
Old M-10 South....26
Old M-10 North....28

AH PAH CREEK WATERSHED....28
Roads Worked....28
B-1100....28
B-1070....30

FUNDING....30

FUTURE WORK....30

References Cited....32

APPENDICES....33
APPENDIX A: Biological Assessment....33
APPENDIX B: Roads Survey Data....67
McGarvey Creek Watershed....67
Ah Pah Creek Watershed....73
APPENDIX C: Glossary....75

List of Tables

Table 1: Lower Klamath Watershed Restoration Plan Prioritization Table............5
Table 2: Funding..30
Table 3: Pre/Post Work Done on the *M-1000*...67
Table 4: Pre/Post Work Done on the *M-800*...67
Table 5: Pre/Post Work Done on the *M-800 Spurs*...69
Table 6: Pre/Post Work Done on the *M-400*...70
Table 7: Pre/Post Work Done on the *Old M-10 South*.......................................71
Table 8: Pre/Post Work Done on the *Old M-10 North*.......................................72
Table 9: Pre/Post Work Done on the *B-1100*... 73
Table 10: Pre/Post Work Done on the *B-1070*..74
Table 11: McGarvey Creek Project Spending..76
Table 12: Ah Pah Creek Project Spending...77

List of Figures

Figure 1: Location of Project Area..2
Figure 2: McGarvey Cut Unit Map..7
Figure 3: Ah Pah Cut Unit Map...8
Figure 4: McGarvey Creek Road Construction History....................................9
Figure 5: Ah Pah Road Construction...10
Figure 6: Mapping Symbols...15
Figure 7: Road Prescription Illustrations..17
Figure 8: Example of Road Profile and Measurements.....................................18
Figure 9: McGarvey Road Classification Map...21
Figure 10: Ah Pah Road Classification Map...22
Figure 11: M-1000, M-800 + Spurs, & M-400 Site Maps..................................24
Figure 12: Old M-10 Site Map...27
Figure 13: B-1100 Site Map..29
Figure 14: B-1070 Site Map..31

INTRODUCTION

From June through October, 1998, the Yurok Tribe conducted a watershed restoration program that was divided into two coordinated projects:

1. Training of watershed restoration techniques to Tribal members (including heavy equipment operation).

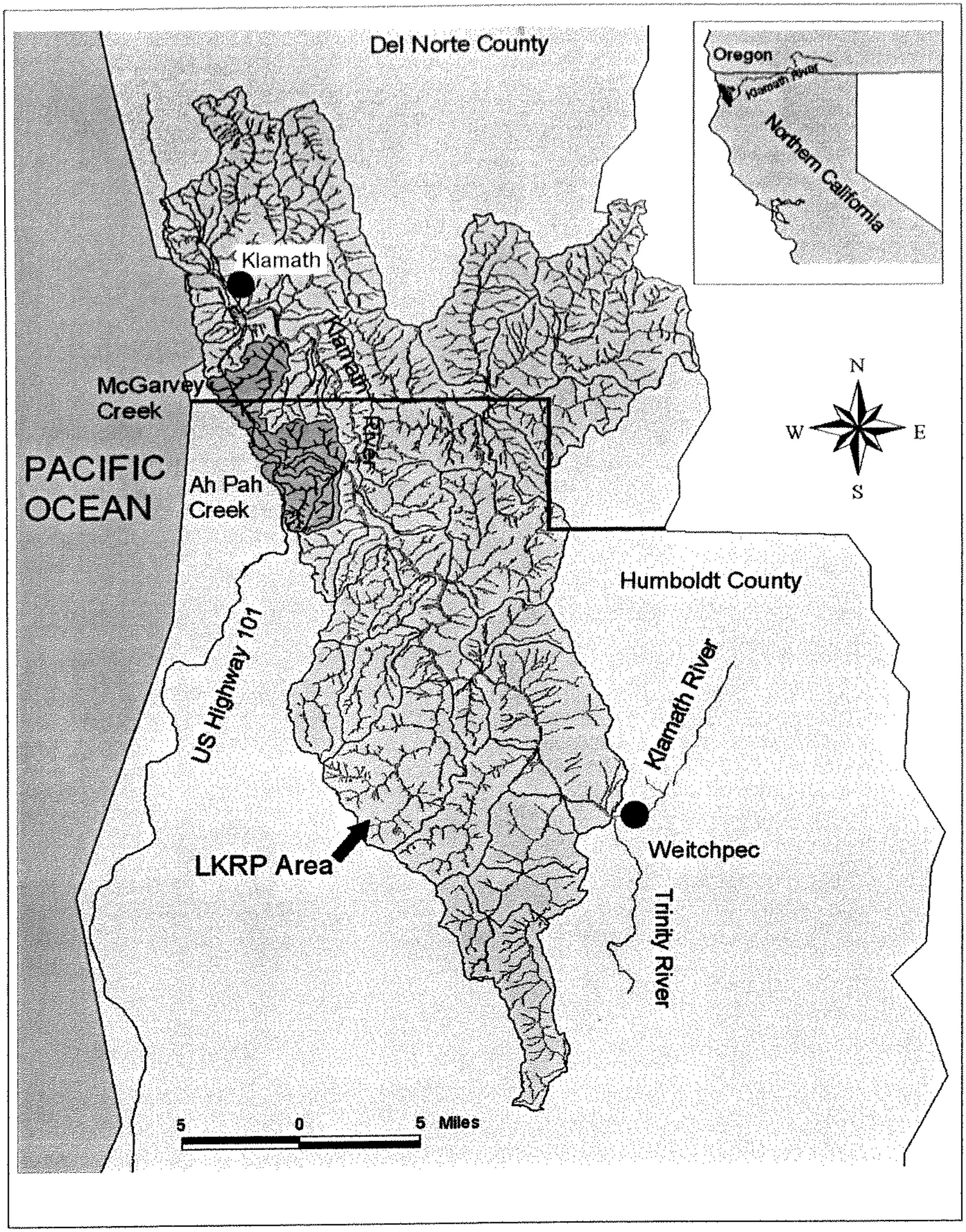
2. Implementation of the hydrologic decommissioning of roads owned by Simpson Timber Company, located within the Yurok Reservation &/or ancestral Yurok territory.

This program, as part of the Lower Klamath River Partnership's long-term watershed restoration goals, was intended to fulfill two principal objectives:

1. To return the Klamath River fisheries to their healthiest possible condition, by...
   - ➢ improving stream/riparian habitat in watersheds identified as immediate priority work areas.
   - ➢ treating the most critical erosion and/or chronic sediment sources in each watershed in the most cost-effective way, by...
     - hydrologic decommissioning/obliteration of road and skid trails.
     - road upgrade/improvements for erosion control.
     - slope stabilization.
     - improvement of stream channel morphology.
2. Jobs training and employment opportunities.
   - ➢ Development of the technical skills and the long-term availability of watershed restoration jobs for Tribal members.

Location

The training and implementation program took place within the McGarvey and Ah Pah Creek watersheds, both located in the lower portion of the Klamath River Basin, a 12,000 square mile drainage basin extending through Northern California and Southern Oregon (see Figure 1). The McGarvey Creek watershed lies within Humboldt and Del Norte Counties in California (in Townships T12N-13N, and Ranges R1E-2E), on the "Ah Pah Ridge" and "Fern Canyon" 7.5 minute USGS quadrangle maps. Ah Pah Creek lies entirely within Humboldt County (Townships T11N-12N, and Ranges R1E-2E), upon the same quadrangles. The headwaters of both creeks border Redwood National/State Park, along the Prairie Creek Redwoods portion of the "Redwood Parks Bypass" (U.S. Highway 101), approximately $3^3/_4$ miles south of Klamath, California.



Legend:

Project Area

Klamath River Basin

Figure 1: Location of Project Area within the Lower Klamath River Basin

Land Status
The Yurok Tribe's ancestral lands make up an area of approximately 320,000 acres. The Yurok Klamath River Reservation is approximately 56,000 acres, and was created by Federal actions between 1853 and 1891. The Reservation encompasses a strip of land one mile wide on each side of the Klamath River, from its confluence with the Trinity River at Weitchpec, California, to its mouth at the Pacific Ocean.

Currently, 7,400 acres of the 56,000-acre Yurok Reservation is held in trust status. Simpson Timber Company and a few other private landowners control more than 85% of the land within the boundaries of the reservation. A smaller portion of the Reservation consists of public lands managed by Redwood National/State Parks, the United States Forest Services, and the Bureau of Land Management.

Prairie Creek Redwoods State Park and the California Department of Transportation manage approximately 1.6 $mi.^2$ of the upper McGarvey Creek watershed. Approximately 0.1 $mi.^2$ of the lower Ah Pah Creek basin is comprised of a tribal allotment. Simpson Timber Company, for commercial timber production, manages the rest of the land within these 2 drainages. The lower portions of the Simpson-owned McGarvey Creek and Ah Pah Creek actually lie within the Yurok Reservation boundaries.

Fisheries Background
Historically, Klamath River steelhead and spawning adult salmon, including spring and fall run Chinook and Coho species, once numbered more than a million each year. The total annual salmon harvest and escapement to the Klamath Basin averaged 300,000 to 400,000 fish between 1915 and 1928 (Rankel 1978). But now these fish are in serious decline, as their abundances have fallen significantly enough to warrant Federal listings under the Endangered Species Act.

LAND USE HISTORY

Tribal Use
For centuries Yurok people have lived along the Pacific Coast and inland along the Klamath River. The river and the ocean have become the central focus of Yurok Tribal life. In the early 1900's, anthropologist Alfred Kroeber noted that the Yurok language and oral history reflected the relationship between the people and the Klamath River. Yurok myths and legends are rich with references to the river. Indeed, nearly every aspect of Yurok life was, and continues to be bound to the river's fisheries (Yurok Strategic Plan, 1999).

Fishing

Although the first impacts of white settlers upon the valleys of the Klamath River Basin were related to gold mining and refining, those settlers quickly recognized the wealth and importance of the river's fisheries. Competition with the Yurok people, over those resources, soon began. By the 1930's, a booming commercial fishing industry was well established upon the river and its outlying ocean. Innumerable photographs and postcards from the '30's through the early 1960's hail Klamath, California as the "Salmon Fishing Capital of North America." Even as the commercial fishery began to decline, in the 1970's and '80's, the Klamath River remained a recreational salmon fishing Mecca.

Timber Harvesting

The harvesting of timber has remained one of the main economic staples for the Lower Klamath River Basin's portion of the "Redwood Empire" for more than a century. Although logging only locally impacted the forests in the early days, the advent of powerful hydraulic technologies allowed timber cutting to quickly spread across the Klamath Basin.

By the 1940's, clear-cutting had begun within the McGarvey and Ah Pah Creek basins, and by the early 1960's approximately 50% of both drainages had been logged (Yurok Tribe, 1997). By 1994, essentially all old growth trees from both creeks had been removed (Figures 2 and 3). Roads were constructed concurrent with harvest operations in the McGarvey/Ah Pah basins (Figures 4 and 5). Most logging roads in the watersheds were constructed with in-sloped or crowned prisms and with inboard ditches. These roads were built within steep inner gorge localities, as well as in gentler upland hill slope areas.

Tourism

With the dramatic decline in both the fishing and timber industries, tourism now remains the number one source of income for the Lower Klamath River region. Tourism is so intimately connected to the redwood forests and to recreational fishing that the protection and restoration of both is paramount to local economic well being. Restoration of logged watersheds offers the greatest potential for restoration of the fisheries.

PRIORITIZATION OF THE LOWER KLAMATH WATERSHEDS

The choice of the McGarvey and Ah Pah Creek drainage basins as hosts for the initial (training/implementation) phase of the Tribe's strategic plan for the Lower Klamath River was based largely upon the management decisions of Tribal, Federal, and private agencies, working together.

Long-Range Planning

Significant long-term improvement of the anadromous Klamath River fishery is dependent upon many factors, with two major components being:

1) in-stream water flows.
2) habitat restoration and stabilization.

A Long-Range Plan was developed by Kier & Associates (1991) for the Klamath Restoration Program (Public Law 99-552). Pages 3-21 to 3-25 of the plan states that, "The low number of anadromous salmonids in the Lower Klamath Tributaries is directly related to sediment problems. ...Only changes in land use management and large-scale watershed stabilization efforts can effectively address these problems and begin the process of recovery of the Lower Klamath tributaries. ...Only by reducing the sediment supply of the entire Klamath River Basin, and allowing time for natural recovery, can the current problems be fully resolved."

A Project Advisory Committee, the Lower Klamath Restoration Partnership (LKRP), composed of representatives of the Yurok Tribe Natural Resources Department, Simpson Timber Company, and the California State Coastal Conservancy has developed a comprehensive "Watershed Restoration and Enhancement Plan" for the Lower Klamath River Sub-basin. The Lower Klamath Sub-basin was identified as the sub-basin with the highest number of "critical" and "high priority" watershed problems requiring treatment (see Figure 1).

The McGarvey and Ah Pah Creek tributaries were prioritized as immediate candidates for restoration, both having high restoration potential and habitat that is relatively intact, with good connectivity and biological diversity (Table 1).

Table 1: Lower Klamath Watershed Restoration Plan Prioritization Table

Sub-Basin	**Restoration Potential**					Distance of Anadromy	Drainage Area	Miles of Road/
	Stream Accessibility Rating(0-5)/ Qualifier*	In-Channel Feasibility Rating(0-5)/ Qualifier*	Anadromous Species Diversity Rating(0-3)/ Qualifier*	Total Rating/ Qualifier*	**Priority**	(Mi.-Mouth to Barrier/ Qualifier*)	(Sq. Mi.)	# of Cross-ings
Ah Pah Creek: Mainstem	4/3	5/3	3/3	12/3	**1**	3/3	6.8	77.6/ 282
Ah Pah Creek: South Fork	4/3	5/3	3/3	12/3	**2**	1.4/3	2.4	19.8/ 228
McGarvey Creek	4/ 3	5/ 3	3/ 3	12/ 2.67	**3**	4/ 2	8.6	65/ 206
Hoppaw Creek	4/ 3	5/ 3	2/ 2	12 2.33	**4**	0/ 0	4.9	29.4
Saugep Creek	4/ 3	5 2	2/ 3	12/ 2.67	**5**	.75/ 2	1.7	8.8
Tarup Creek	5/ 3	4/ 2	3/ 3	12/ 2.33	**6**	0/ 0	4.9	37.7

Sub-Basin	Restoration Potential					Distance of Anadromy (Mi.-Mouth to Barrier/ Qualifier*)	Drainage Area (Sq. Mi.)	Miles of Road/ # of Cross-ings
	Stream Accessibility Rating(0-5)/ Qualifier*	In-Channel Feasibility Rating(0-5)/ Qualifier*	Anadromous Species Diversity Rating(0-3)/ Qualifier*	Total Rating/ Qualifier*	Priority			
Ah Pah Ck.: North Fork	5/ 3	4/ 3	2/ 3	11/ 3	7	4 SH/ 3	6.8	43.2/ 274
Hunter Creek	4/ 3	4/ 3	3/ 3	11/ 3	**8**	9.8 SH/ 2	23.8	134.3
Omagaar Creek	4/ 3	5/ 2	2/ 2	11 2.33	**9**	1.5/ 2	2.5	12.7
Waukell Creek	5/ 3	4/ 1	1/ 1	10/ 1.67	**10**	2.5/ 2	3.6	28.6
Terwer Creek	3/ 3	3/ 2	3/ 3	9/ 2.67	**11**	11.1 SH/ 2	32.8	168.4
Pecwan Creek	4/ 3	2/ 2	3/ 3	9/ 2.67	**12**	1.5/ 2	27.7	114.8
Tectah Creek	2/ 3	3/ 3	3/ 3	9/ 2.67	**13**	0/ 0	19.9	112.5
High Prairie	4/ 3	4/ 2	1/ 3	9/ 2.67	**14**	0/ 2	4.2	19.7
Blue Ck.: West Fork	2/ 3	3/ 2	3/ 2	8/ 2.33	**15**	0/ 0	13.5	36.7
Roaches Creek	2/ 3	3/ 2	3/ 3	8/ 2	**16**	0/ 0	29.5	150.9
Blue Ck.: Lower Main	3/ 3	1/ 3	3/ 3	7/ 2.67	**17**	11/ 3	24.2	143.1
Johnson Creek	1/ 3	4/ 2	3/ 3	7/ 2.67	**18**	0/ 0	3	12.1
Bear Creek	2/ 3	3/ 2	2/ 2	7/ 2	**19**	0/ 0	19.3	61.5
Surpur Creek	2/ 3	3/ 1	2/ 3	7/ 2	**20**	0/ 0	5.7	68.2
Salt Creek	4/ 3	3/ 2	0/ 0	7/ 1.67	**21**	.5/ 2	4.4	11.4
Blue Ck.: Crescent City Fork	1/ 3	2/ 3	3/ 3	6/ 2.33	**22**	9.5/ 2	22.7	23.1
Blue Ck.: Upper Main	0/ 3	1/ 3	3/ 3	4/ 2.67	**23**	4.25/ 3	49.9	12.1
Tully Creek	2/ 3	2/ 1	1/ 2	4/ 2	**24**	0/ 0	17.3	98.9
Little Surpur Creek	2/ 2	4/ 2	2/ 3	4/ 1.33	**25**	0/ 0	2.6	20
Mettah Creek	2/ 1	3/ 2	3/ 2	4/ .67	**26**	0/ 0	10.7	62.8
Pine Creek	2/ 2	2/ 1	3/ 1	4/ .67	**27**	11/ 2	47.8	164
Blue Ck.: Nickowitz	0/ 3	1/ 2	2/ 2	3/ 2.33	**28**	0/ 0	15.3	22
Cappell Creek	2/ 2	2/ 1	1/ 2	3/ 1.33	**29**	0/ 0	8.6	32.5
Morek Creek	1/ 2	4/ 1	1/ 2	2/ 1.33	**30**	0/ 0	4.0	22.6

***Qualification Index:** This gives professionals an opportunity to qualify their ranking based upon: **3** = frequent/long-term observation, supported by recorded data. **2** = ranking based on long-term field observations, w/ little or no supporting data. **1** = ranking based upon a few observations from a localized portion of the creek. **0** = not enough data for ranking.

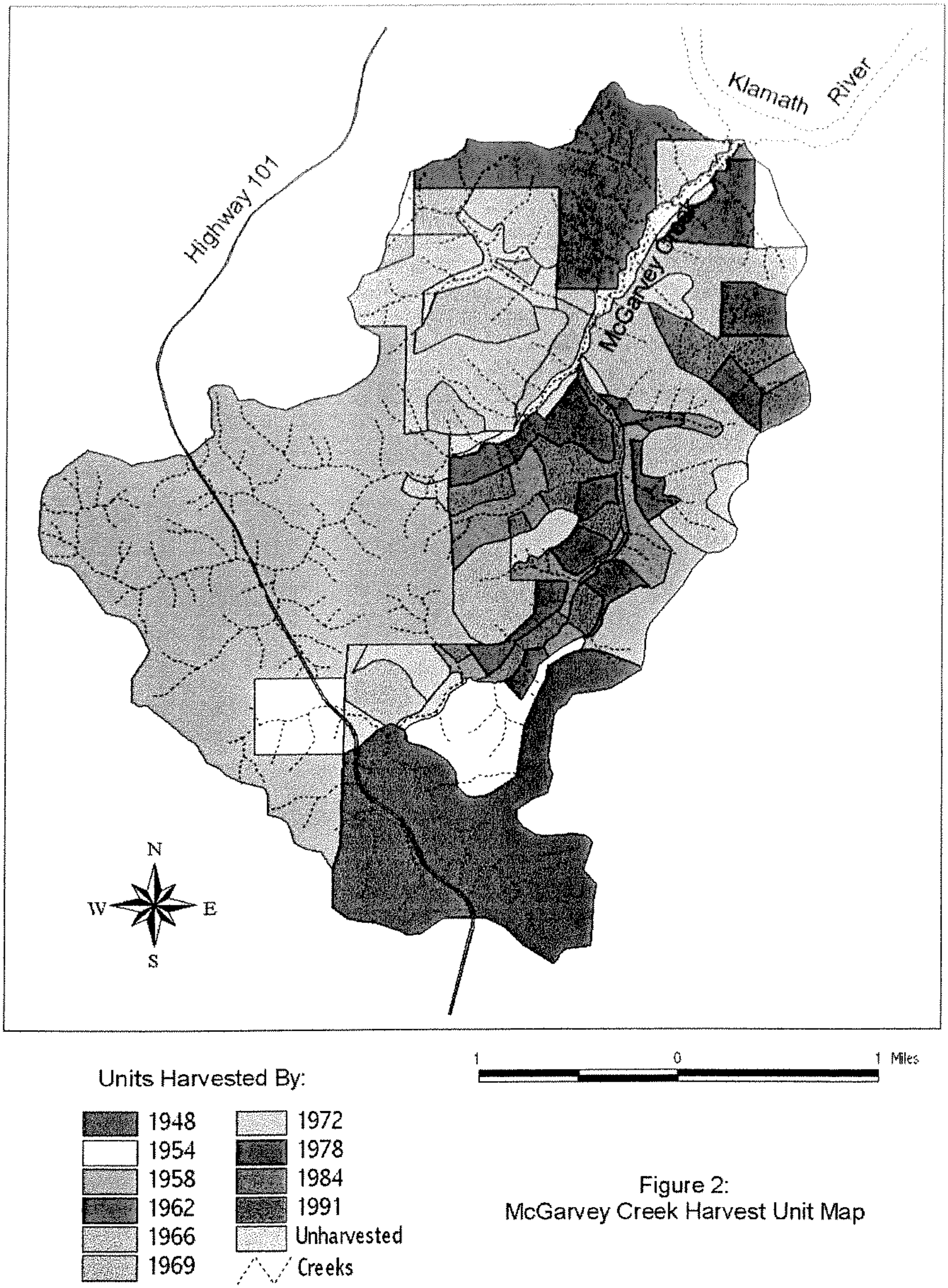


Figure 2:
McGarvey Creek Harvest Unit Map

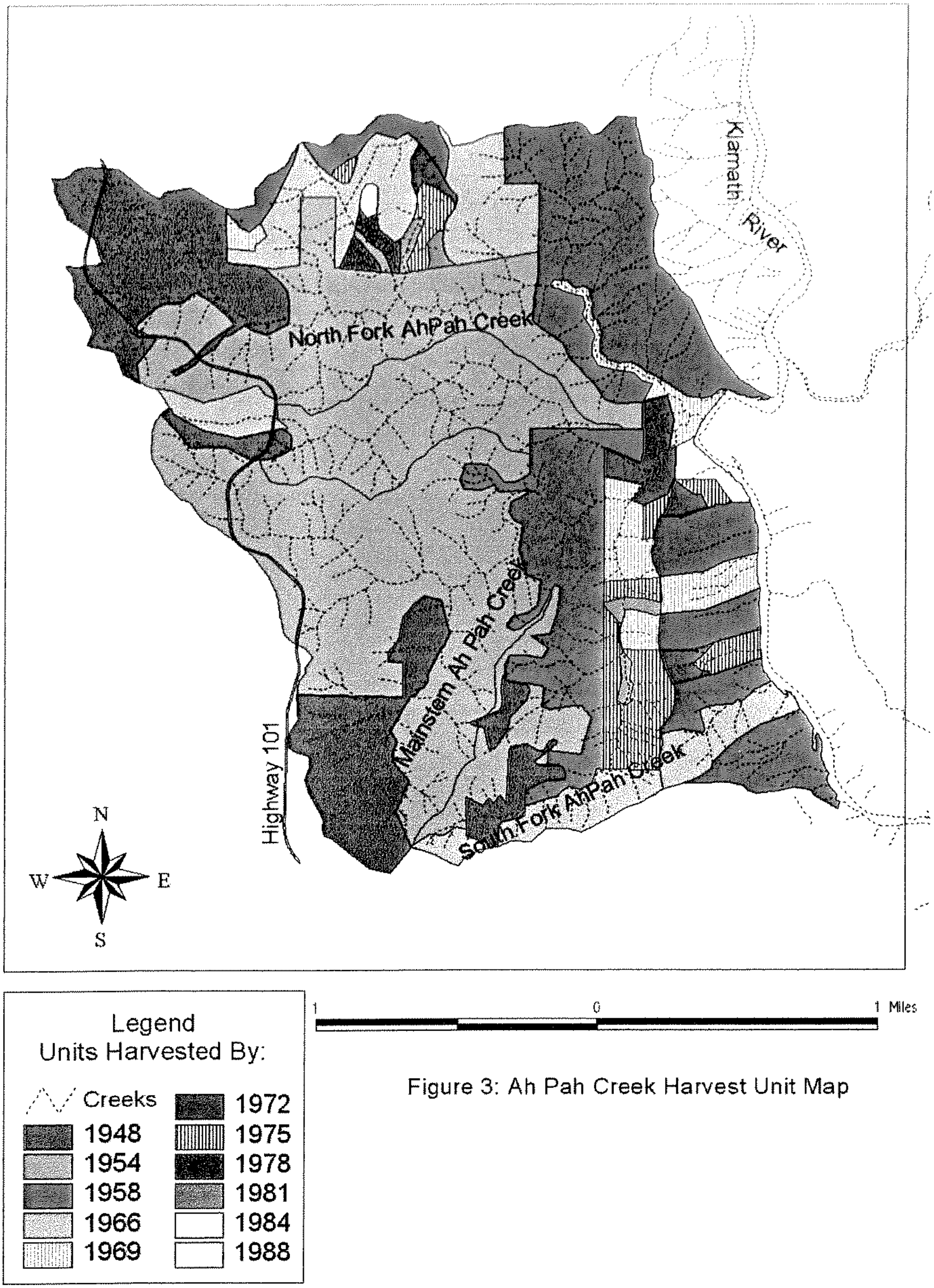


Figure 3: Ah Pah Creek Harvest Unit Map

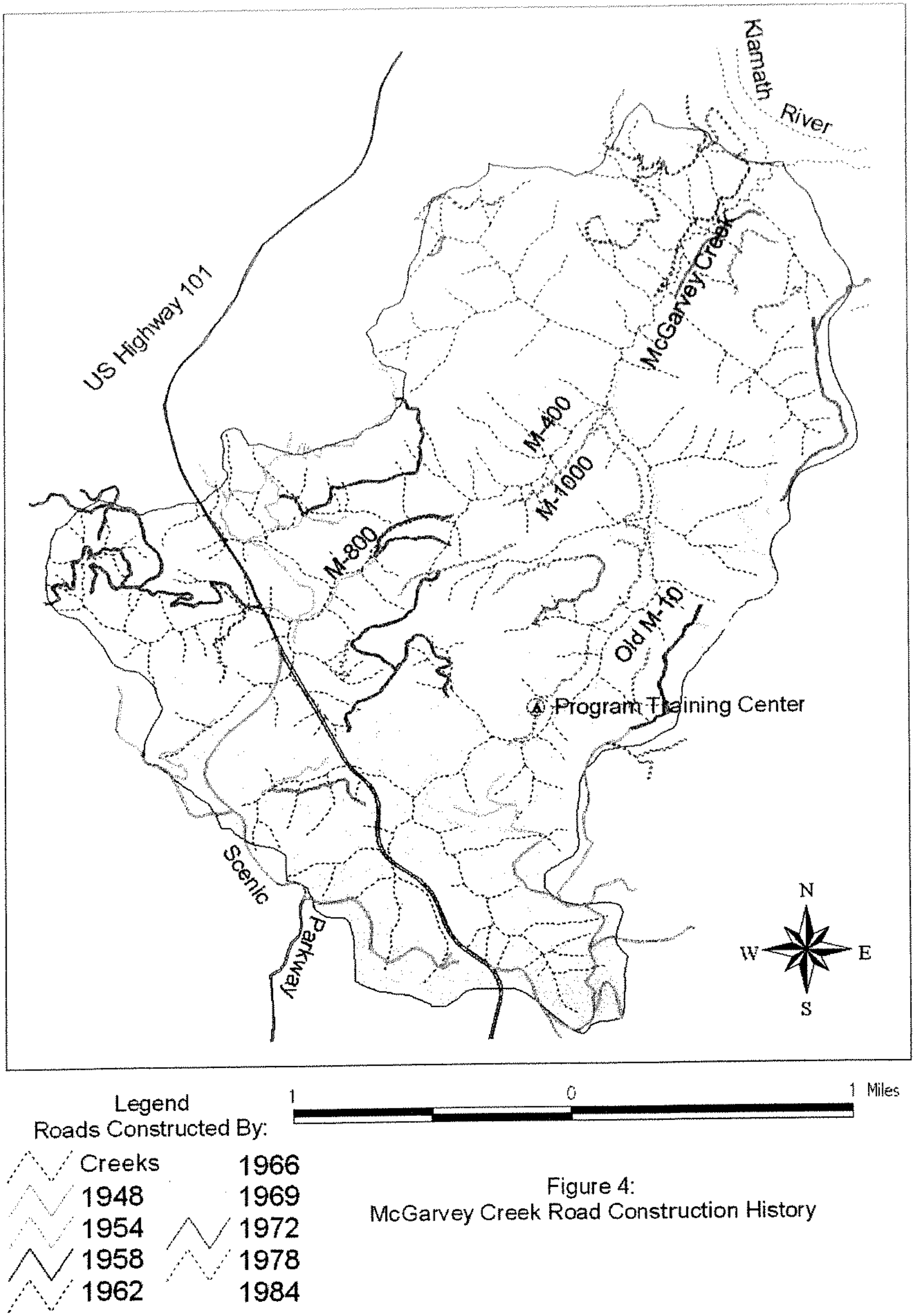


Figure 4:
McGarvey Creek Road Construction History

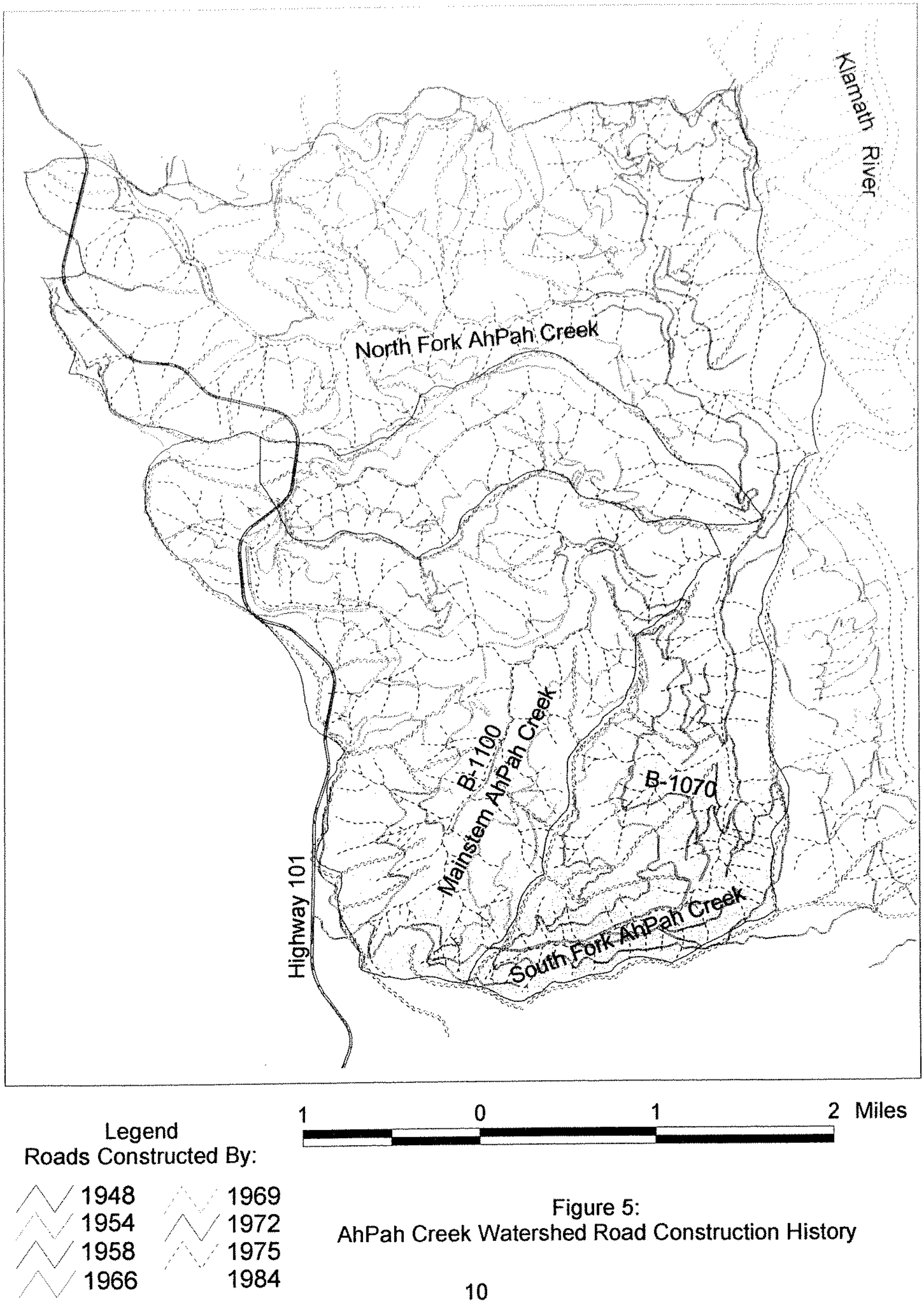


Figure 5:
AhPah Creek Watershed Road Construction History

PHYSIOGRAPHY OF THE WATERSHEDS

Geology

Rocks of the "Franciscan (geological) Formation" underlie both the McGarvey and Ah Pah Creek drainage basins. This formation is a collection of rocks comprised predominantly of sandstones, shales, and minor conglomerates, which are composed of the fluvial/oceanic sediments that are commonly found along a continental shelf margin. These sediments were essentially thrust up onto the edge of North America by faulting, as part of the construction of the North Coast Ranges. This mountain building began around the end of the Jurassic Period (approximately 140 million years ago), and continues to this day.

"Splinters" of metamorphic rocks have become incorporated into the Franciscan Formation. These rocks were derived from the deep-sea volcanic and sedimentary rocks upon which the continental shelf sediments were originally deposited. High pressures and temperatures associated with deep burial beneath the continental sediments, have essentially "baked" these deep-sea rocks into denser forms. These denser metamorphic rocks are more resistant to weathering than surrounding sedimentary rocks, and are therefore being exposed (by erosion) as prominent monolithic knobs known as "knockers."

Since the rocks of the Franciscan Formation were generally uplifted along the continental rim by faults, they have been broken up and pulverized along fault zones. Shearing along these zones is typically so intense that the rocks are ground into clays, which form extremely unstable hill slopes. This, coupled with heavy seasonal precipitation, greatly increases the potential for landslides within the McGarvey/Ah Pah region.

McGarvey Creek Watershed

The McGarvey Creek watershed totals approximately 8.6 $mi.^2$ (5,504 acres) and includes the entire hydrologic watershed draining into McGarvey Creek. Prairie Creek State Park and the California Department of Transportation manage approximately 1.6 $mi.^2$ of the upper watershed. The remaining 7 $mi.^2$ is managed by Simpson Timber Company for commercial timber production.

Ah Pah Creek Watershed

The Ah Pah Creek watershed totals approximately 17.1 $mi.^2$ (10,944 acres) and includes the entire hydrologic watershed draining into Ah Pah Creek, along with the east side of South Fork Ridge, which drains directly into the Klamath River. Approximately 17 mi^2, encompassing the entire upper watershed, are managed by Simpson Timber Company for commercial timber production. Approximately 0.1 $mi.^2$ of the lower watershed is managed as the White Sanders Tribal allotment.

PRIORITIZATION OF WORK SITES

During the winters of 1996-1998, Pacific Watershed Associates (P.W.A.) and the Yurok Tribe conducted watershed assessment surveys in the McGarvey and Ah Pah Creek watersheds, respectively. Recommendations from their detailed assessment reports (P.W.A., '97; Yurok Tribe, '98) were considered in choosing the roads for decommissioning during 1998's Training/Implementation Program. Some of the factors that were considered were:

- Simpson Timber Company's long-range management plans.
- location within the watershed.
- erosion potential and associated volumes.
- cost effectiveness of the work proposed.
- potential delivery to a stream channel.

The cumulative volume of sediment that could be prevented from entering McGarvey and Ah Pah Creeks was 507,294 yd.^{3}. Using a projected cost between \$7.50 and \$8.00 per cubic yard, it would cost \$ 3,982,727 to treat all identified work locations within the two watersheds. Due to limited funds, only work locations of the highest priority were actually treated.

TRAINING PROJECT

Introduction

On June 8, 1998, an 18-week Training and Implementation Program began. Eighteen Tribal members were employed into the program, which was broken into 2 phases:

1. A six week long "classroom" phase that taught the basic principles and methodologies currently used by watershed restoration technologists.
2. A twelve week long training/implementation phase consisting of practical (hands-on) field experience.

The initial 6 weeks of classroom training ended on July 16th, after which the 12-week field training/implementation project began. This secondary training officially ended on October 8th, 1998, but was extended up until October 29th, thanks to some additional funding. Most of the classroom and field training was contracted from and provided by TerraWave Systems, Inc.

Training Approach

TerraWave's training was designed around the principles and standards employed by the Watershed Restoration Division of Redwood National Park. This was done under the assumption that some trainees (and possibly the Yurok Tribe itself) might one day accept contracts for work within the parks.

TerraWave's trainers stressed an interdisciplinary approach to watershed restoration, in which ground personnel, site managers, and program managers (administrators) were all given a basic understanding of each other's skills, goals, and duties, such that they became a more integrated team. The trainers employed some very progressive teaching techniques, including the use of background music, recess-style breaks (with recreational activities), and a focus upon the differing cognitive and learning styles of the trainees.

Training Site Location
The first phase of training included classroom instruction of the general concepts of watershed restoration, and was given at a training center located on a specifically selected landing, near the junction of the M-10 and M-1200 roads, in the McGarvey Creek watershed (see Figure 4). This landing was chosen because it displayed several of the features that students would be encountering in the field (e.g. gullying/diversion off overlying skid trails; cracks and scarps due to incipient road-fill failure; and underfit stream culverts). The training center included a 20-foot diameter "yurt" (circular hut) which was provided for classroom-style (audio-visual) activities. A trailer was utilized as a portable "laboratory" for hands-on exercises and computer-based data entry.

The second phase (hands-on field training and implementation) took place along several roads prioritized within both the McGarvey and Ah Pah Creek watersheds. These roads are described in the "Prioritization of Work Sites" section of this report.

Training
The initial 6 week training period focused upon the basic concepts involved in watershed restoration work, including the skills and duties of ground personnel and of heavy equipment operators. Important auxiliary information, such as First Aid and medivac procedures, heavy equipment safety, and maintenance skills made up an additional portion of the training.

Ground personnel were taught how to perform geomorphic investigations, and how to prescribe, design, survey, layout, and implement labor intensive treatments. They were further trained to assist and supervise heavy equipment operations, and to provide logistical support during the project.

Heavy equipment operators were trained to perform restoration treatments, as prescribed by ground personnel. Thus, they were taught how to physically effect road and skid trail decommissioning/obliteration; to excavate unstable fill in stream &/or "Humboldt" type crossings; to excavate unstable fill at potential and active slides and earth-flow locations; to scarify compacted surfaces for accelerated revegetation; and to eliminate any diversion potentials. The majority of their operational skill-level training actually took place during their work in the implementation phase of the program.

Post-Training
Of the 18 Tribal members that were trained during the program, 4 had already received instruction in watershed assessment work, and 6 had previous experience operating heavy equipment. Five of the graduates from the training program were retained as ground

personnel for winter (1998-'99) assessment work in the Tectah Creek watershed. Three more graduates were hired back, in March of '99, as additional ground personnel for Tectah assessment work. At least 4 of these 8 graduates will become heavy equipment operators for the Tribe's restoration efforts, during the summer of 1999. Three other graduates will be hired back during the summer of '99; 2 as heavy equipment operators and another as their supervisor.

GENERAL METHODOLOGY

The 1998 McGarvey/Ah Pah Watershed Training and Implementation Program utilized the "McGarvey Creek Watershed Assessment" (P.W.A., 1997) and the "Ah-Pah Creek Watershed Assessment" (Yurok Tribe, 1998) reports to prioritize roads for hydrologic decommissioning. Those reports offer detailed descriptions of the assessment process that was used. The 1998 Training/Implementation Program outlined seven basic (post-assessment) steps used to target/prioritize roads, to prepare them for work, and to implement their hydrologic decommissioning.

Step #1: Air Photo Analysis

The first step was to assemble and analyze aerial photographs, digital and/or relevant maps and literature available for the McGarvey and Ah-Pah Creek basins. Air photos were used to determine whether hill slopes were cable yarded or tractor logged. Not as much emphasis was placed upon a hill slope if it was cable yarded, because it was less likely to have water diversions, since no tractor-skidded trails were created. Skid crossings and associated water diversions were relatively common if a hill slope had been tractor logged. Roads and skid trails were located and mapped, using stereo-pair air photo analysis. The air photographs were later used (wherever possible) as bases for the geomorphic mapping described in Step #3, below.

Step #2: Road Primary-Line Survey

Once a road was chosen for decommissioning, a field crew of two to three people measured the entire road length and bearings with a tape measure and compass. Beginning at one end of the road, the crew took compass bearings and hung station flagging every one hundred feet, as they walked to the other end. Flags were, ideally, hung high against the cut bank, so they wouldn't be lost or destroyed when the bulldozer reopened the road. After they finished their "primary-line," the road crew transcribed their data onto graph paper (with aid of a protractor), thus creating a two-dimensional plan view of the road and its directions. Sites that were previously identified, during the 1997-1998 winter assessments, were added to the primary-line for relative location information.

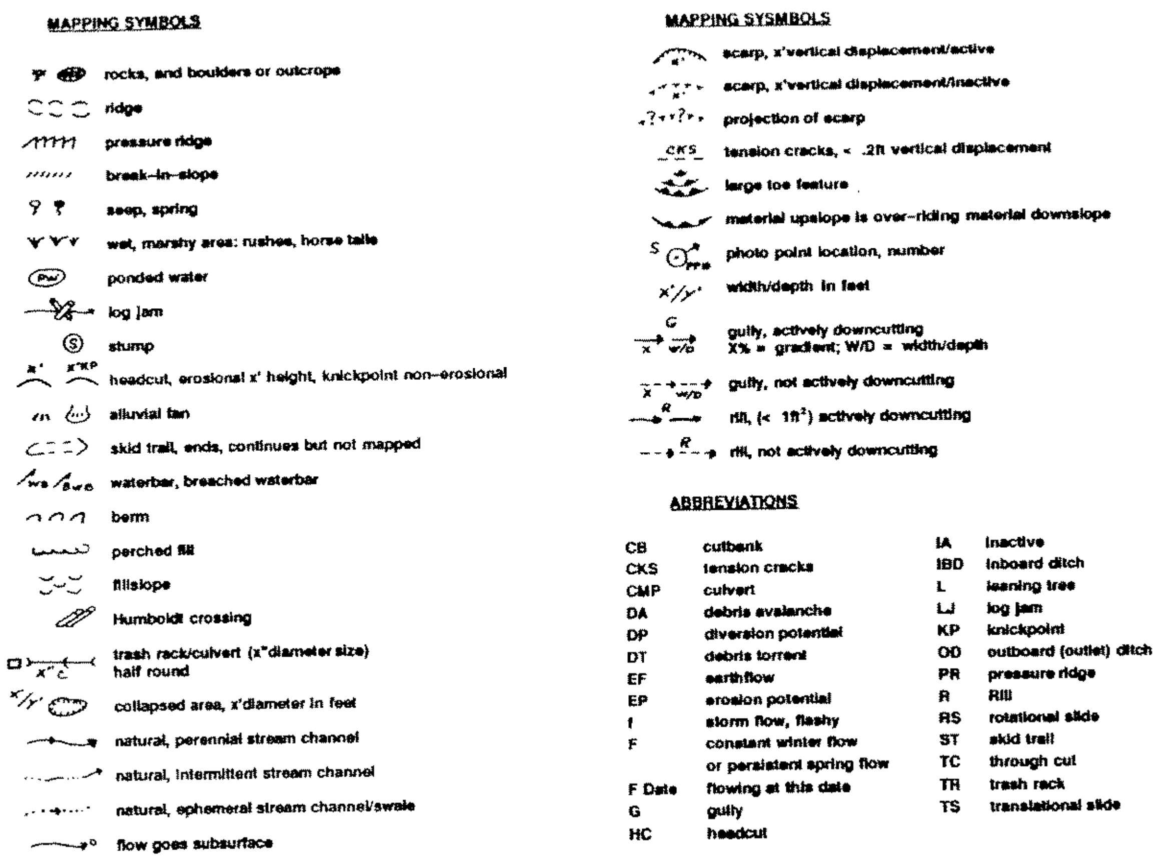
Step #3: Geomorphic Mapping

Geomorphic mapping is the mapping of locations and spatial relationships between drainage and geographical features within a given area. The mapping is used to help identify drainage diversions that are located up-slope from roads to be decommissioned, such that these diversions can be corrected at their source. It would be pointless to treat a diversion problem on a road to be decommissioned, if the source of the problem is above the road and can ultimately fail back onto the road after decommissioning was completed.

During the 1998 field program, crews traversed the slopes above and below targeted roadways, then identified and mapped all road and skid trail stream crossings, as well as diverted waterways (i.e., rills & gullies). Mapping was done on mylar overlays attached to air photos of the area. If vegetative cover obscured air photos, the features were instead recorded upon "primary-line" maps (see Step #2).

Other information recorded during geomorphic mapping included site number/location, type of site, erosion potential, erosional features such as landslides, debris torrents, washed out stream crossings, springs/seeps, and all culvert locations (including ditch-relief culverts). Landmark-features, such as dry swales, landings, and old-growth snags/stumps were sometimes added for location-reference in the field. The symbols used for mapping these features are shown in Figure 6.

Figure 6



Step #4: Site Prescription and Layout

After the geomorphic investigations were completed, remedial treatments were identified for each problem site, and then "prescribed" in notes, upon maps, and on survey flagging (at the site) for the heavy equipment operator to see. The limits of the excavation work were also flagged, and given three-letter code designations to let the operator know his/her whereabouts within the site. For example, the top and bottom of an excavation were flagged as "TOP" and "BOT," respectively. Other three-letter designations included IBR (in-board road), OBR (out-board road), OBF (out-board fill), LEC (left edge of cut), REC (right edge of cut), CTH (cut to here), and FTH (fill to here). This procedure is generally referred to as road "lay-out."

The process of identifying treatments ("prescriptions") for erosional problems began at the end of the road where decommissioning would begin. Since heavy equipment cannot move across a road after it has been decommissioned (without damaging the work), decommissioning is essentially done while "backing out" of a road. Illustrations of the road prescriptions that were used during the training/implementation program are shown in Figure 7.

The field crew also measured a profile across each excavation site, using either a survey tape/clinometer or a laser range finder. The profile was run along a line from the TOP to the IBR, then across the road bench to the OBR, and down to the BOT. From this profile, a set of formulas was used to estimate the volume of road fill material that needed to be excavated during decommissioning. An example of a site profile (including the formulas used to estimate fill volume) is shown in Figure 8.

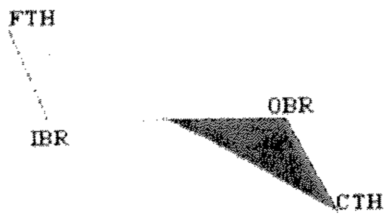
Step #5: Implementation

Ground personnel were in charge of site management. This included overseeing the work done by heavy equipment operators. The ground crews made certain that the operators excavated fill down to the original natural-ground surface. This surface was approximated by: 1. locating excavated stumps, and using them as indicators of original base level.

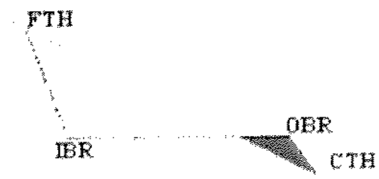
2. identifying discolored (organic rich) soil horizons, presumably at the level of buried topsoils.
3. imitating the contours of surrounding natural slopes.

Ground personnel were also responsible for correcting water diversions (e.g., across or along roadways), by ensuring that all diverted surface drainage was redirected into natural channels. Ground crews monitored the work done by heavy equipment operators and their machinery. By tracking an operator's equipment work- vs. downtime in their notebooks, ground personnel could perform comparative analyses of the relative efficiencies of each worker and operator team (i.e., a bulldozer & excavator working in tandem). Since heavy equipment time was the most expensive part of the project, each pair of dozer/excavator operators were taught to work as a coordinated unit, thus making them as cost-effective as possible. Both operators had to develop teamwork, to ensure that they didn't move dirt more times than necessary, and to reduce the time lost in waiting for each other to perform his or her respective tasks.

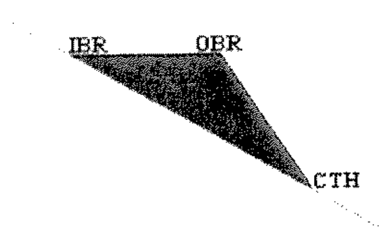
Figure 7: Road Prescription Illustrations



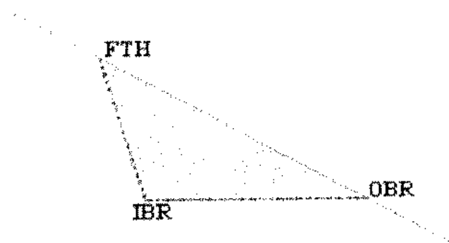
OS:
Outslope- Unstable fill material and local storage provide for complete natural recontouring.



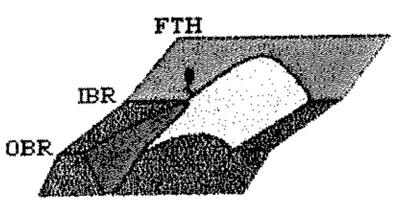
FOS:
Fill Outslope- Unstable fill material does not provide complete outsloping and additional fill may be imported.



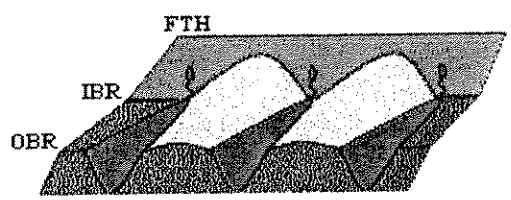
EOS:
Export Outslope- Unstable fill material requires exportation to a stable location, due to inadequate local storage.



DS:
Disposal Site- A stable location where fill can be stockpiled.



XRD:
Cross Road Drain- Full Excavation is not required, usually occurs around a spring or wet area.



ROS:
Rolling Outslope- The road is dipped to accomodate multiple wet areas.

Legend:

= fill to be excavated
= Cutbank
= Spring
= area where fill can be stored
= Stable ground
= Natural slope

Worksheet For Stream Crossing Volumes

Site#: ________ Date:________

1. Field Measurements (marked with asterisk)
2.

L1	4 ft.	D1	3 ft.
L2*	22 ft.	D2	9 ft.
L3	35 ft.	L4*	___ ft.
S1*	___ deg.	S2*	___ deg.
SL1*	___ ft.	SL2*	___ ft.
W1*	15 ft.	W2*	39 ft.
CW1*	3 ft.	CW2*	3 ft.
US Grade*	___ deg.	DS Grade*	___ deg.

For Type 4 crossings

Angle deg.	Distance ft.	Code (UES, Top, IBR, OBR, BOT, LES, TRN)
0	0	UES
-39	20	TOP
+23	4	IBR
-3	22	OBR
-30	40	BOT
-32	20	LES

2. Cross-Sectional Area Calculations:

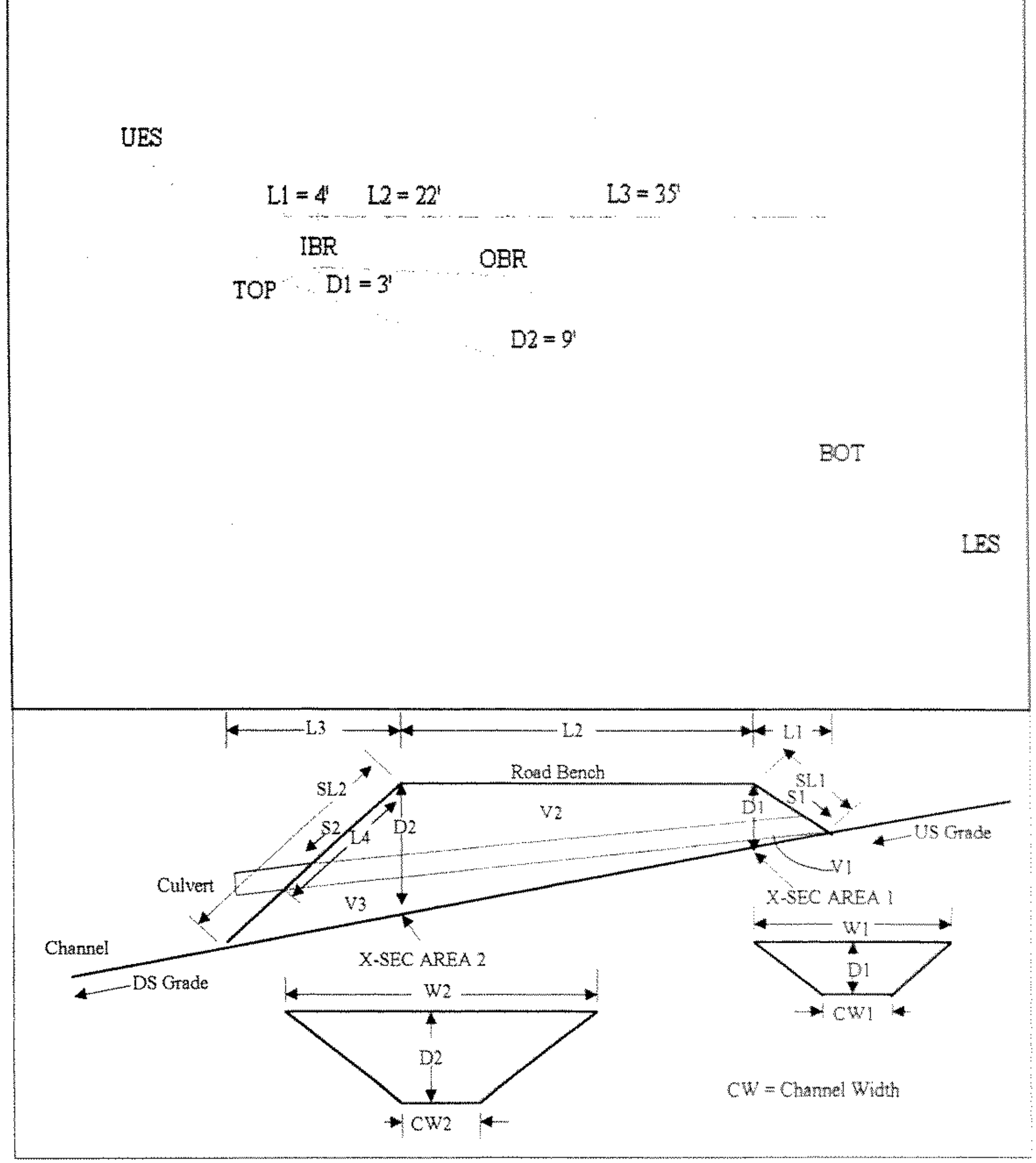
	Erosional:	Excavation:
A1 = D1 (W1 + CW1)/2 =	27 ft^2	___ ft^2
A2 = D2 (W2 + CW2)/2 =	189 ft^2	___ ft^2

3. Volume Calculation for each Section:

V1 = A1 x L1 / 2.5 =	43 ft3	___ ft^3
V2 = ((A1 +A2) / 2) L2 =	2,376 ft^3	___ ft^3
V3 = A2 x L3 / 2.5 =	2,646 ft^3	___ ft^3

4. Erosional Volume (E_V) = 5,065 ft^3 / ^{27} = 188 yd^3 (E_V = V1 + V2 + V3)
4. Excavation Volume = ________ ft^3 / ^{27} = ________ yd^3

Figure 8: Example of Road Profile and Measurements



Initially, the bulldozers were used to brush open those roads that were chosen for hydrologic decommissioning. The dozer operators were generally sent to "prepare" the fluvial and mass movement work sites (by removing as much fill material as possible) ahead of the excavators. Next, each dozer/excavator team began working in tandem to remove all targeted fill from the site. The excavators would typically "switch-back" down to the bottom of the fill margin, and then feed material up to the bulldozers. The dozer operators then pushed this material up a ramp-like road, to a disposal area off of the site. Disposal areas included the backsides of stable landings, proximal skid trails, through-cuts, and FOS sites. At times, a site was so large that an excavator had to "double-bale" its fill material (i.e., shovel it twice) up to a bulldozer, for removal.

Step #6: Post-Work Site Survey

At the end of the field season, a post-excavation volume inventory was taken of all stream crossings that had been removed by heavy equipment. This "post-work site survey" was used to appraise the effectiveness and accuracy of the volume-estimation process, used by field workers during the initial 1997-1998 winter assessment projects.

The post-work site surveys were performed in essentially the same manner as described at the end of Step #4: Site Prescription and Layout (page 16). Using either a survey tape/clinometer or a laser range finder, the field crew measured a profile along the bottom of the (now-excavated) stream channel. This profile was run from the original TOP flag down to the BOT flag. An additional (cross-sectional) profile was measured from the LEC-to-the-REC flags, incorporating the slope angles of the channel walls and the stream-bottom channel width. Utilizing the same set of formulas used to estimate the volume of road fill material in Figure 8 (page 18), the actual volume of fill material that had been excavated from each stream crossing was determined, and compared with the pre-work field estimates. The percentage accuracy, generated from these comparisons, was recorded in the database tables shown in Appendix B.

Step #7: Effectiveness Monitoring

All phases of the McGarvey/Ah Pah implementation project were photo-documented as part of an ongoing effort to improve the effectiveness of future restoration efforts. Pre- and post-restoration photo point localities were established along the entire lengths of the roads that received work, to evaluate the results of that work and to monitor the recovery of the watershed through time. Photos were typically taken looking down-road, from photo point-to-photo point. The photo points were sequentially located at the limit-of-view from each previous photo. Stream crossings were photographed separately, from above and below, to better illustrate their cross-sectional morphologies. All photo points are consecutively numbered, and are marked in the field with yellow-flagged monuments.

PROJECT IMPLEMENTATION

Roads were chosen for implementation based upon:

1. the cost-effectiveness of the work required for their hydrologic decommissioning.
2. their erosion/delivery potential.

Prior to initiating any work, and as a result of the Lower Klamath Long-Range Plan (Kier, 1991), tribal staff and Simpson representatives set up goals and objectives for Lower Klamath River restoration. As part of the process, a long-range road plan was generated. Roads were prioritized as either "upgrade" or "decommission," based upon location within the watershed, soil type, and future timber harvest plans (Figures 9 & 10). Upgrade roads were to be maintained for future timber harvest plans, but would require upgraded culverts and drainage structure for maximum drainage efficiency. "Decommission" roads would have their fill removed from all crossings, and from all fill failures noted to have delivery potential to a stream.

Work Priority

McGarvey Creek watershed roads that were designated as "high priority" for work included the:
M-1000 (decommission)

- M-800 and spurs (decommission)
- OLD M-10 (decommission)
- M-1400 (upgrade)
- M-920 (upgrade)
- M-100 (upgrade)
- M-10 (upgrade)

Ah Pah Creek watershed roads that were designated as "high priority" for work included the:

- B-1100 (decommission)
- B-1070 (decommission)
- B-1882 (decommission)
- B-1200 (upgrade)
- B-1010 (upgrade)
- B-1000 (upgrade)
- S-Line (upgrade)
- B-Line (upgrade)

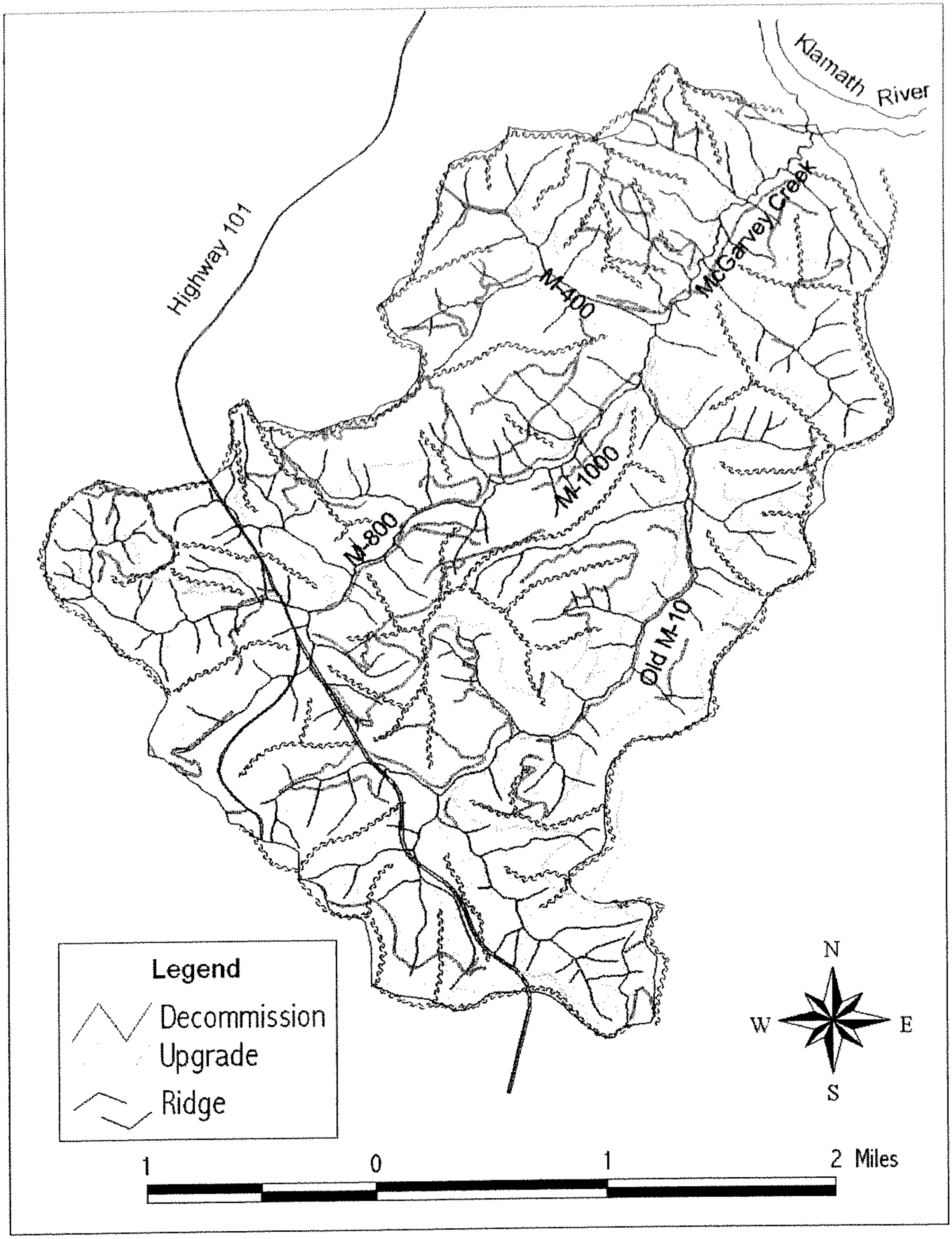
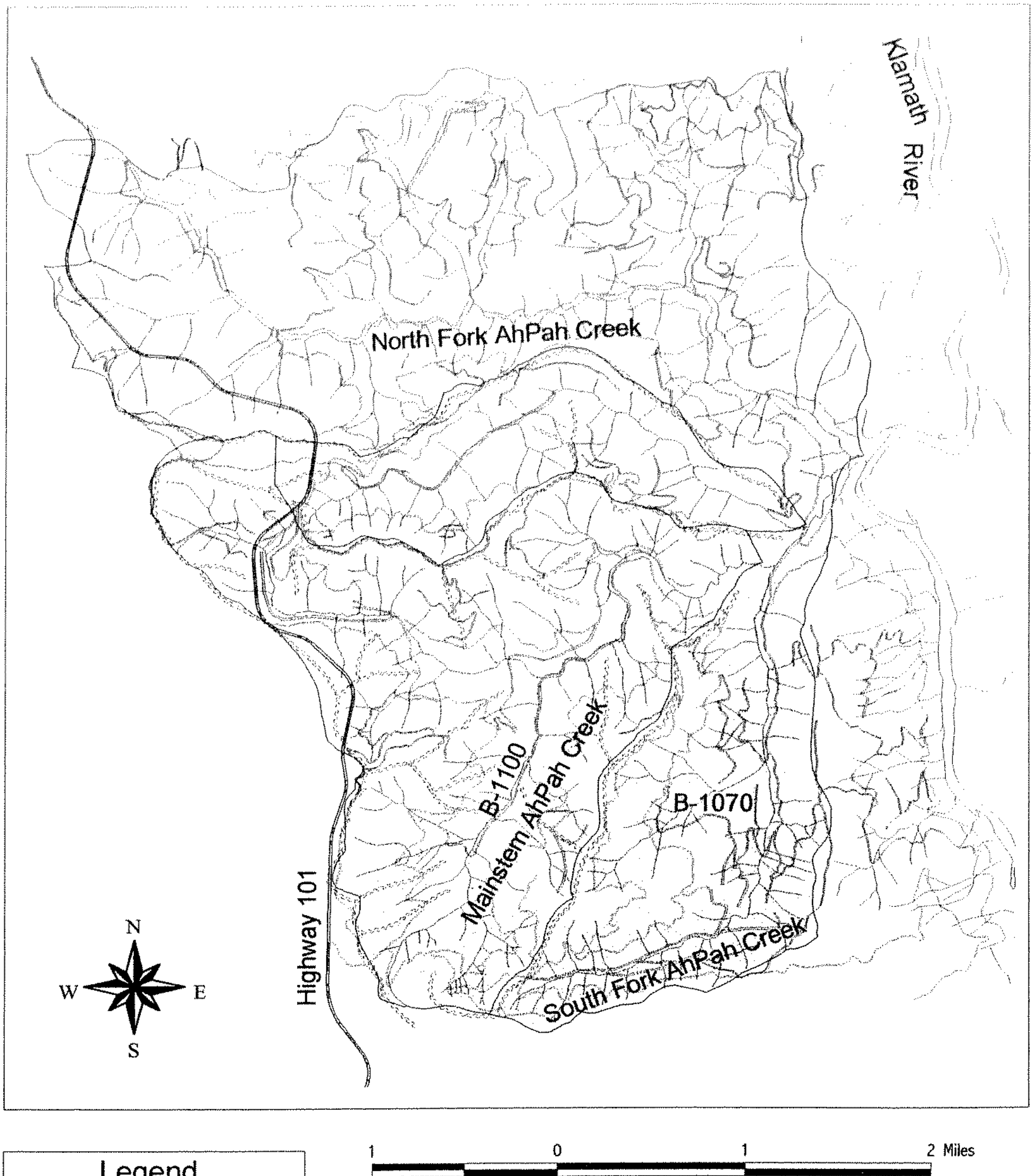


Figure 9: McGarvey Creek Road Classification Map



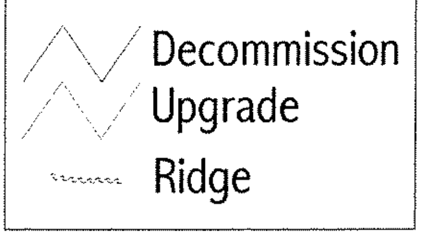


Figure 10: Ah Pah Road Classification Map

McGARVEY CREEK WATERSHED

Roads Worked in the McGarvey Creek Watershed include the:

- M-1000 (decommission)
- M-800 and spurs (decommission)
- M-400 (decommission / upgrade)
- OLD M-10 (decommission)

M-1000

The M-1000 was a relatively short road, but had a very high erosion potential, with a greater than average amount of road fill volume. The road was located on a break in slope some 100 to 300 feet above the west fork of McGarvey Creek (see Figure 4). Hill slopes were steep, generally with greater than 50% grade. Constructed in 1978, the total road length for the M-1000 was approximately 3,362 feet. Although of fairly recent construction, the road was showing severe signs of gravity-related "aging," in the form of a multitude of mass movements.

The McGarvey Creek Watershed Assessment Report (P.W.A., 1997) identified 14 sites for treatment, along the M-1000 (Figure 11), and estimated that the road would have a total of 21,203 $yd.^3$ of road fill to be removed. Post-surveys, done after the implementation work, estimated that 17,697 $yd.^3$ of fill were actually removed. These figures are within approximately 17% of each other, overall. Some of the smaller fluvial sites (seeps and small springs) did not receive full excavation, but were instead cross-road drained.

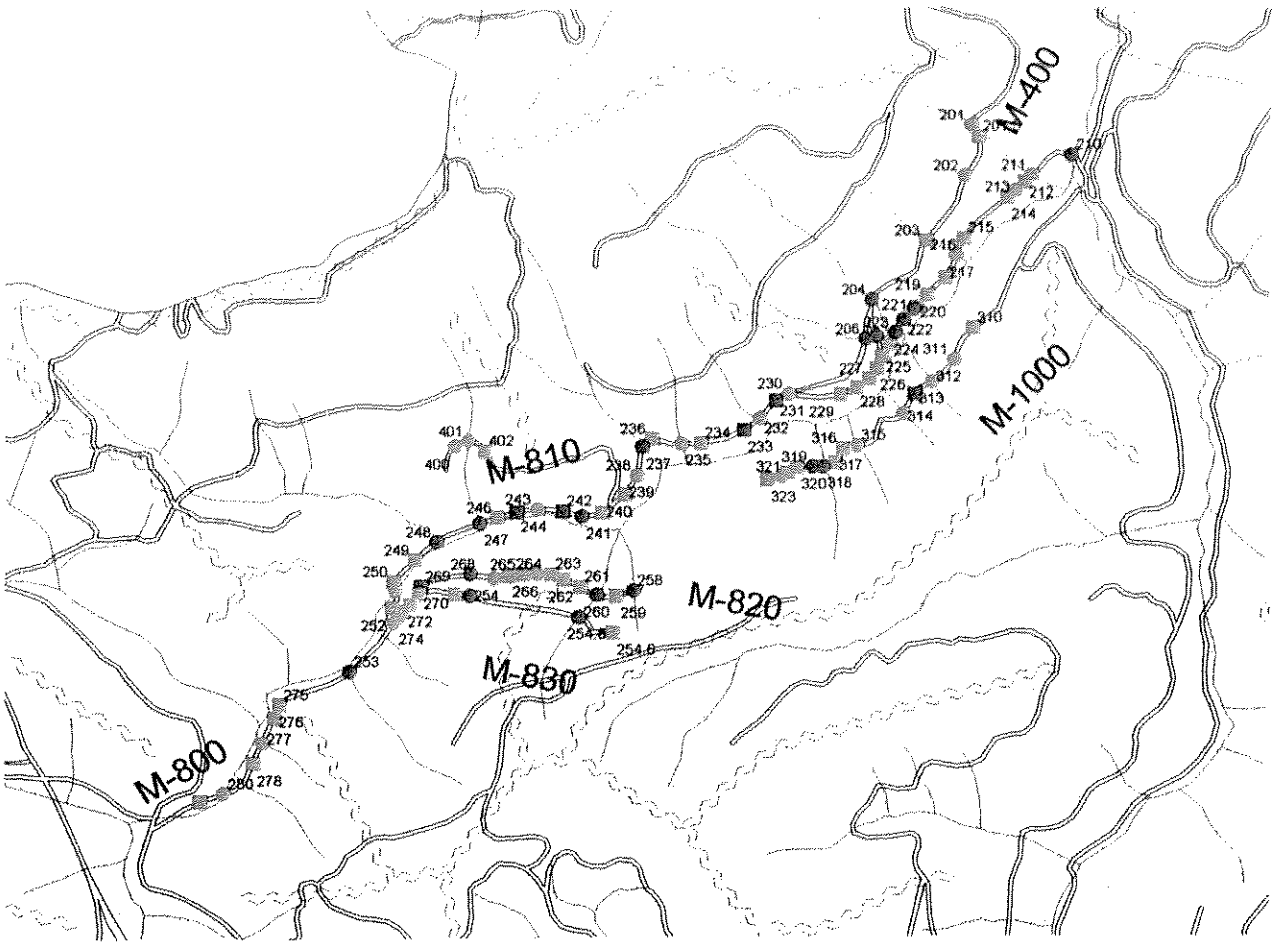
M-800 + Spurs

The M-800 was the main hauling artery for the entire west fork of McGarvey Creek. The road extended from the confluence of McGarvey's main stem and west fork, to the Newton Drury Bypass/Parkway Road (see Figure 4). Several spur roads were used to access areas within the drainage that could not be reached from the M-800. Logs were skidded from surrounding areas to landings on these spur roads. There, the logs were loaded onto trucks for transport to the mill.

Hydrologic decommissioning was done along the M-800 and four of its spur roads. The total road lengths for the M-800 and its spurs were:

- M-800 <u>10,242 feet</u> Year of construction: 1958/1969
- M-805 <u>2,000 feet</u> Year of construction: 1969
- M-810 <u>2,190 feet</u> Year of construction: 1969
- M-820 <u>2,684 feet</u> Year of construction: 1958
- M-830 <u>2,252 feet</u> Year of construction: 1969

See Figure 11 for site locations and designations. Appendix B: Table 5 presents the amount of fill volumes removed from the M-800 spurs.



Note: Sites are numbered in consecutive order. Not all numbers are shown.

Legend

- High Erosion Potential Mass Movement
- Moderate Erosion Potential Mass Movement
- Low Erosion Potential Mass Movement
- High Erosion Potential Fluvial Erosion
- Moderate Erosion Potential Fluvial Erosion
- Low Erosion Potential Fluvial Erosion
- Ridge Line

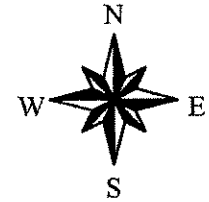


Figure 11: McGarvey Creek Watershed Roads
M-1000, M-800 + Spurs, & M-400 Site Maps

M-800

The M-800 was located within the inner gorge, and (locally) along the flood plain of the west fork of McGarvey Creek (Figure 11). The M-800 was the main access road for timber harvesting in McGarvey's west fork. The road was roughly 1.9 miles long, and was constructed in two different time frames. The upper mile was constructed in 1958, beginning at the top of the watershed. In 1958, access to the M-800 was off of the S-Line, from the Pacific coast. As timber harvest progressed down through the drainage basin, the rest of the M-800 was constructed, with final completion in 1969.

P.W.A.'s McGarvey Watershed Assessment Report (1997) estimated that a total of 16,949 $yd.^3$ of fill would be removed from the M-800. Post-surveys (done after the implementation work) indicated that 18,083 $yd.^3$ were actually removed. These figures were within 6% of each other, overall. Some of the smaller fluvial sites (seeps and small springs) did not receive full excavation, but instead were cross-road drained. Appendix B: Table 4 presents the amount of road fill volume estimated for removal during decommissioning, versus the amount actually removed during the 1998 implementation project.

M-805

The M-805 was a newly discovered road (i.e., it hadn't previously appeared on any maps or been found during the field assessment). The M-805 was discovered during the up-slope geomorphic mapping of the M-800. The road provided two work sites; both were stream crossings. Post-work volume surveys showed that 1,285 $yd.^3$ of fill was removed from these sites (Appendix B: Table 5).

M-810

The M-810 hosted 3 work sites, with a pre-estimated volume of 1,911 $yd.^3$ (Figure 11). Only 728 $yd.^3$ were actually removed (Appendix B: Table 5). The Humboldt crossings at sites 1 and 2 were not as large as predicted, which explains the 63% difference between the volumes estimated vs. removed.

M-820

The M-820 was a rather complicated road to work on, due to earth-flow complexes, and large red alder regrowth. The earth-flow complexes were avoided to minimize any risk of reactivation. The road had 5 work sites, with a combined pre-estimated volume of 4,167 $yd.^3$ (Figure 11). In all, 3,890 $yd.^3$ of road fill were actually removed. These figures are within 7% of one another (Appendix B: Table 5).

M-830

The M-830 was positioned directly down-slope from the M-820 (Figure 11), so many of the problems that were encountered on the M-820 extend down to the M-830. A debris torrent that originated from the M-820, actually removed a portion of the M-830 road bench. The M-830 offered 17 work sites, with a combined pre-work estimate of 7,522 $yd.^3$ of fill volume to be removed. Only 6,544 $yd.^3$ of road material was actually removed. (Appendix B: Table 5).

M-400

When it was constructed in 1966, the M-400 was approximately 3,054 feet long. It was originally designated as an up-grade road. But due to its erosion potential, and its location directly above the M-800 (see Figure 11), it was decommissioned along that section that drains into the west fork of McGarvey Creek.

Appendix B: Table 6 indicates the amount of road fill volume estimated for removal, versus the actual amount removed, from the M-400. The McGarvey Creek Assessment Report (P.W.A., 1997) estimated that sites 201-206 would yield a total of 11,040 $yd.^3$ for removal. There were two new sites discovered during the primary line survey, which added 4,341 $yd.^3$ to the pre-work estimate (for a total of 15,381 $yd.^3$). Post-work surveys estimated that 13,410 $yd.^3$ were actually removed. Once again, some of the smaller fluvial sites (seeps and small springs) did not receive full excavation, but were instead cross-road drained.

Old M-10:

The Old M-10 was constructed in 1966, but was abandoned shortly thereafter, due to maintenance problems (see Figure 4). The (new) M-10 and M-920 were both built up-slope, on gentler ground, to replace the Old M-10. The Old M-10 was broken into two segments for treatment (North and South). A half-mile long "no treatment zone" was designated for the central portion of the road (Figure 12), since it rests in a broad portion of the McGarvey Creek flood plain, and has no more erosion/delivery potential than would a natural stream terrace.

Old M-10 South

The Old M-10 South was approximately 3,455 feet long, and was located within the inner gorge of the main stem of McGarvey Creek (Figure 4). This portion of the Old M-10 was hydrologically decommissioned. A migration barrier was also removed from McGarvey Creek, immediately below site # 150 (Figure 12). There, a large logjam was dismantled and a channel established for fish passage. Logs were strategically placed along the flood plain, as large woody-debris recruitment.

Appendix B: Table 7 lists the amount of estimated vs. actual fill volumes removed from the Old M-10 South. The (pre-work) Assessment Report (P.W.A., 1997), estimated that sites 147-164 would yield 4,522 $yd.^3$ of road material. Post-work surveys estimated that 4,563 $yd.^3$ were actually removed (a difference of only 1%). Some of the smaller fluvial sites (seeps and small springs) did not receive full excavation, but were instead cross-road drained.

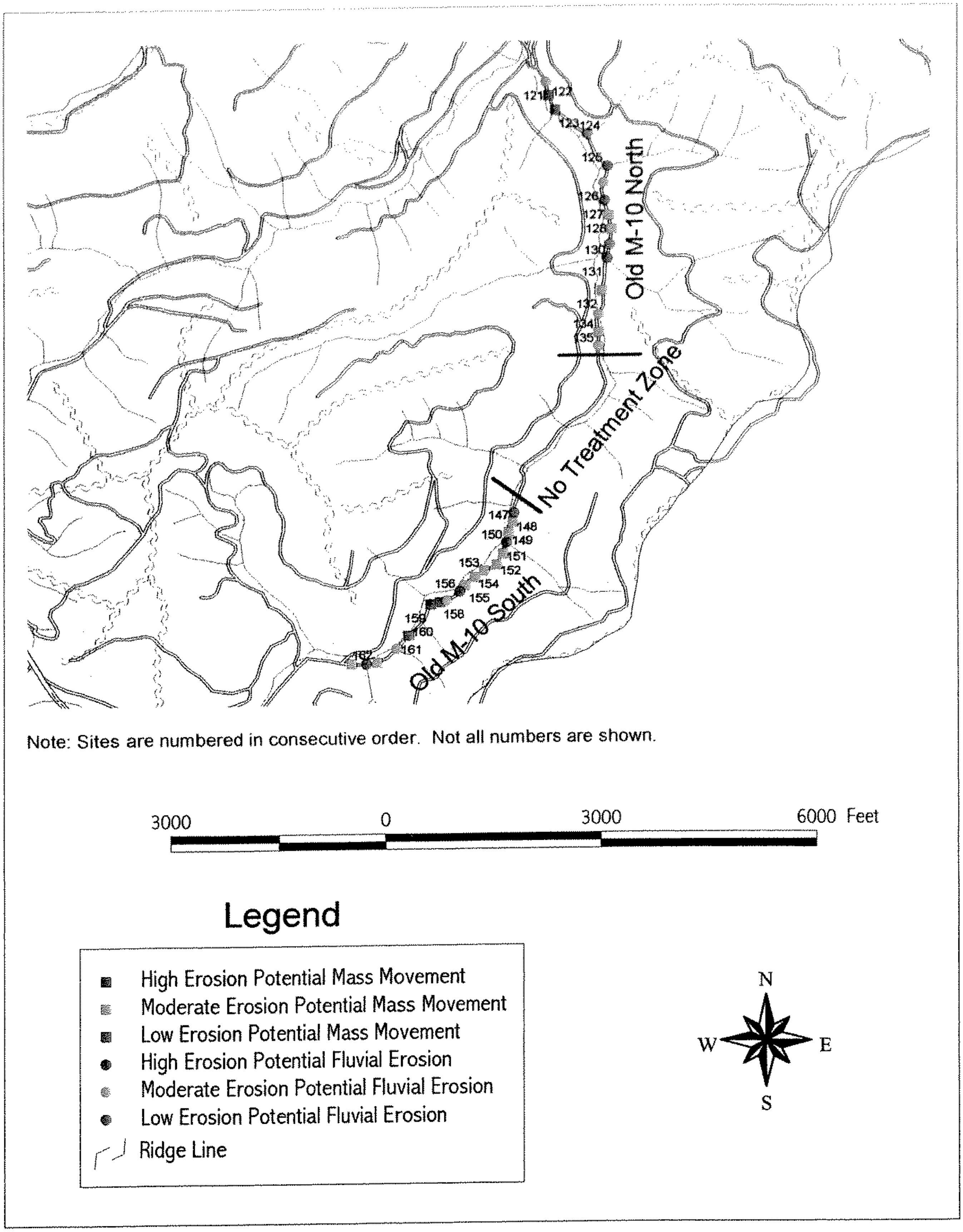


Figure 12: McGarvey Creek Watershed Road Old M-10 Site Map

Old M-10 North

The Old M-10 North was approximately 4,164 feet long. It was located within the inner gorge of McGarvey Creek's main stem (Figure 4), and some segments of the road actually extended down onto the creek's floodplain.

The pre-work Assessment Report (P.W.A., 1997) estimated that sites 121-135 would yield a total of 1,828 yd.^{3} of road fill. After the implementation work was completed, it was determined that 2,201 yd.^{3} were actually removed. These estimates are within 17% accuracy. Appendix B: Table 8 lists the volume figures for the Old M-10 South. Some of the smaller fluvial sites (seeps and small springs) did not receive full excavation, but instead were cross-road drained.

During decommissioning, a fish migration barrier was removed from a tributary to McGarvey Creek, at site #131 (Figure 12). Spawning habitat in the tributary has been minimal, but it has acted as an escapement area for juveniles during high flows.

AH PAH CREEK WATERSHED

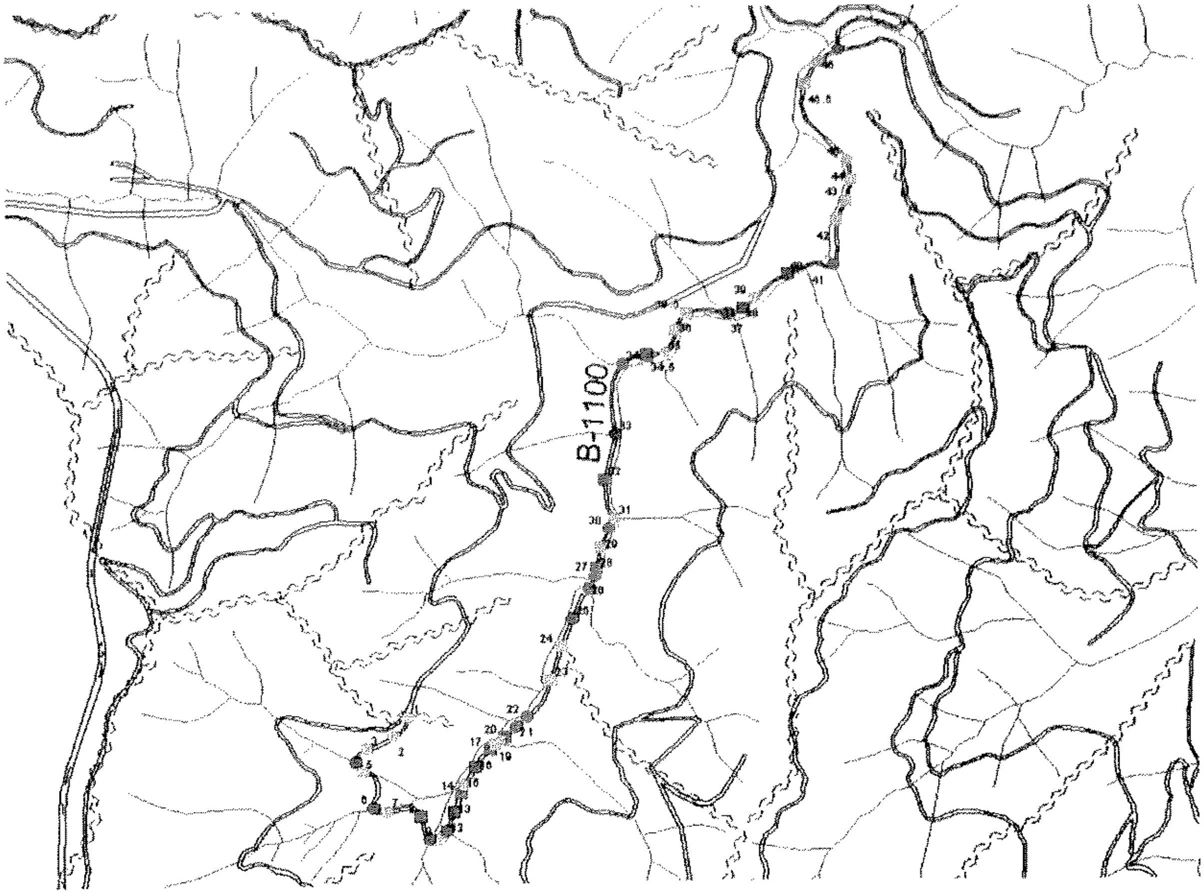
<u>Roads Worked</u> in the Ah Pah Creek Watershed include the:

- B-1100 (decommission)
- B-1070 (decommission)

B-1100

The B-1100 was located along the inner gorge of Mainstem Ah Pah Creek (Figure 13). The road was approximately 3.4 miles long. Road construction generally coincided with timber harvest operations, and as a result, the B-1100 was built during two different time frames. The top 1 mile section of the road was built in 1948, and the lower sections (1.6 miles) were completed in 1969 (see Figure 5).

Appendix B: Table 9 indicates the amount of road fill that was estimated for removal, versus the amount of fill that was actually removed. The Yurok Assessment Report (1998) estimated that for sites 9-40, 7,386 yd.^{3} of road material would be removed. Post-work surveys indicated that 6,745 yd.^{3} were actually removed. These figures were within 9% of each other, overall. Once again, some of the smaller fluvial sites (seeps and small springs) did not receive full excavation, but were instead cross-road drained.



Note: Sites are numbered in consecutive order. Not all sites are shown.

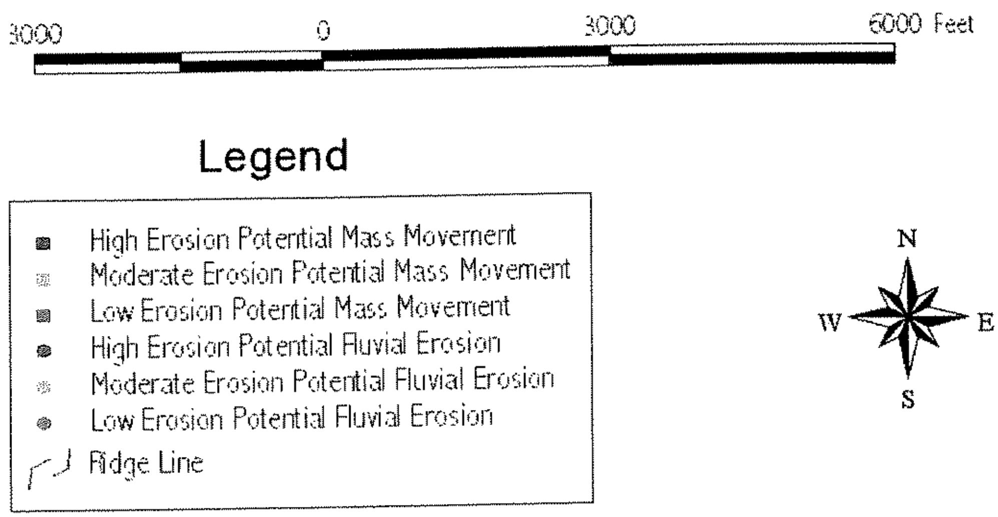


Figure 13: AhPah Creek Watershed Road B-1100 Site Map

B-1070

The B-1070 was constructed in 1958, and was approximately 1.3 miles long. It was located in the South Fork of the Ah Pah Creek Watershed (Figure 5), within inner gorge and upper slope settings.

The Yurok Assessment Report (1998) estimated that for sites 1-8 (Figure 14) there would be a total of 3,424 yd.^{3} of fill removed. Post-implementation work surveys estimated that 6,054 yd.^{3} were actually removed. These 2 figures have a difference of 43%. Assessment estimates for the B-1070 were consistently low because of an unforeseen amount of large woody debris within the fill prism, adding to the complexity of the sites. Appendix B: Table 10 illustrates the amount of estimated fill removal versus the actual amount removed. Some of the smaller fluvial sites (seeps and small springs) did not receive full excavation, but were instead cross-road drained.

FUNDING

Multiple agency grant funds were utilized for the overall project, as presented in the following table:

Table 2: Funding

PROJ. #	AGENCY	CONTRIBUTION		AREA WORKED
586	Fish & Wildlife Service (ERO) FY98	$	99,849.00	B-1100 / B-1070
588	Fish & Wildlife Service (ERO)	$	100,000.00	M-800+Spurs,M-400, Old M-10
587	Fish & Wildlife Service (Klamath Task Force)	$	53,587.00	M-1000
583	NCIDC/Title IV-A	$	99,489.00	Training
582	NCIDC-Heavy Equipment. CSBG	$	163,108.00	Training
581	NFWF – Heavy Equipment	$	110,000.00	Training
568	B.O.R. 1998 (W.R. IN Ah Pah Creek)	$	96,000.00	B-1882, B-1070

FUTURE WORK

Future work for the up coming field season (1999) will include projects in the McGarvey, Ah Pah, and Tectah Creek Watersheds.

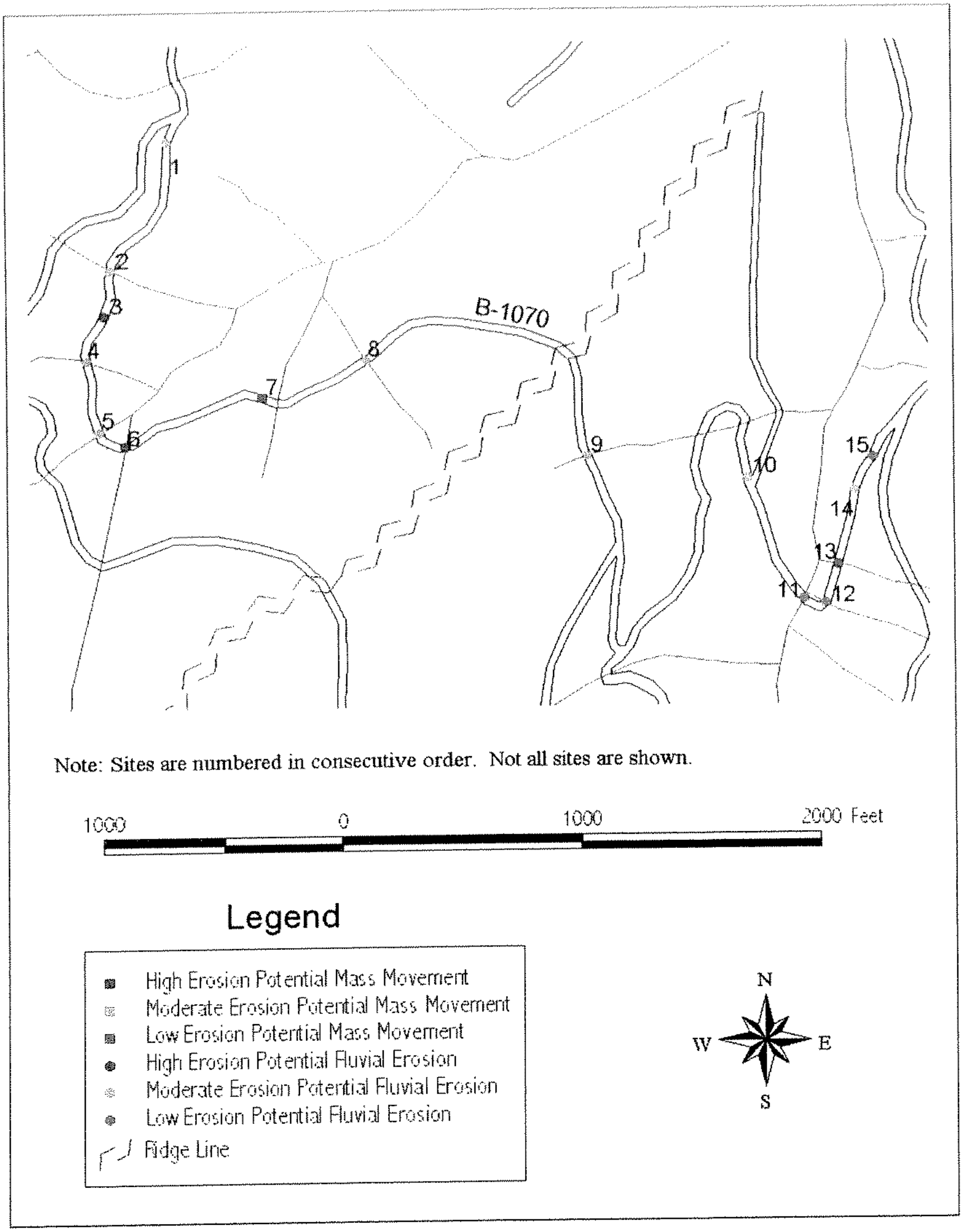


Figure 14: AhPah Creek Watershed Road B-1070 Site Map

References Cited

Kier, W. M., and Associates: Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program; January 1991.

Pacific Watershed Associates: McGarvey Creek Watershed Assessment Report; July, 1997.

Rankel, G. (U.S. Fish and Wildlife Service): Anadromous Fishery Resources and Resource Problems of the Klamath River Basin and Hoopa Valley Indian Reservation, With a Recommended Remedial Action Program; 1978.

Yurok Tribe: Ah Pah Creek Watershed Assessment; December, 1998.

Yurok Tribe: Lower Klamath River Aquatic Habitat Inventory; 1996-1997.

Yurok Tribe: The Yurok Tribe Strategic Plan; May, 1999.

APPENDICES

APPENDIX A: Biological Assessment

A Biological Assessment for the 1998 McGarvey/Ah Pah Watershed Restoration Training and Implementation Program was completed by the U.S. Fish & Wildlife Service, in July of that year. Their assessment report follows, and is included here for the sake of completeness.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
COASTAL CALIFORNIA FISH AND WILDLIFE OFFICE
1125 16TH STREET, ROOM 209
ARCATA, CA 95521
PH:(707) 822-7201 FAX:(707) 822-8411

COPY

July 8, 1998

William T. Hogarth, Ph.D
Regional Administrator
National Marine Fisheries Service
Southwest Region
501 W. Ocean Blvd., Suite 4200
Long Beach, CA 90802-4213

Dear Dr. Hogarth:

Enclosed please find a biological assessment for two watershed restoration projects. In accordance with Section 7 of the Endangered Species Act, the U.S. Fish and Wildlife Service (Service) is requesting formal consultation for the McGarvey and Ah Pah Creek Watershed Restoration Implementation and Training Projects funded by the Service through the Jobs-In-The-Woods Watershed Restoration Program. The projects are on tributaries to the Lower Klamath River in Humboldt and Del Norte Counties.

We request formal consultation be initiated for coho salmon within the Southern Oregon/Northern California ESU and request incidental take for the species. A conference opinion is also requested for chinook salmon in the Southern Oregon and coastal California ESU and critical habitat for both coho and chinook salmon. We have also addressed affects to steelhead trout for the Klamath Mountains Province ESU and for Searun cutthroat trout.

Please contact Paula Golightly, of my staff, at (707)822-7201 if you have questions regarding the assessment.

Sincerely,

Tom T. Kisanuki

(for) Bruce G. Halstead
Project Leader

Enclosure
cc Mr. Don Reck, NMFS - Eureka Field Office

COPY

Biological Assessment
For

McGarvey and Ah Pah Creek Watershed Restoration: Implementation and Training Projects

Jobs-In-The-Woods Watershed Restoration Program
and
Klamath River Restoration Program

U.S. Fish and Wildlife Service
Coastal California Fish and Wildlife Office
Arcata, CA

July 9, 1998

Prepared by: Paula Golightly Date: 7/8/98
Paula Golightly and
David Boyd
U.S. Fish and Wildlife Service

Approved by: Tom T. Kisanuki Date: 7/8/98
(for) Bruce G. Halstead

The Critical Habitat considered in this document is:
Proposed Critical Habitat:

Coho salmon *Oncorhynchus kisutch* (Southern Oregon/Northern California ESU)
Chinook salmon *Oncorhynchus tshawytscha* (Southern Oregon and California coastal ESU)

II. CURRENT MANAGEMENT DIRECTION

The projects have been funded by the following watershed restoration programs:

A. Jobs In The Woods Watershed Restoration Program

The Jobs in the Woods Watershed Restoration Program (JITW) is part of the USFWS contribution to the overall implementation of the Northwest Forest Plan. The USFWS is required to allocate congressionally appropriated JITW program funds and to direct these funds toward watershed restoration projects in northern California, Oregon, and Washington on non-federal lands within the range of the northern spotted owl.

The USFWS offices responsible for implementation of the Northwest Forest Plan are to spend JITW program funds to implement watershed restoration projects that: 1) employ dislocated timber and forest industry workers or workers from timber dependent communities to the extent possible; 2) address actions on non-federal lands identified in watershed analysis, watershed assessments or other written watershed based evaluations; 3) coordinate with ongoing watershed restoration projects on federal lands where possible; and 4) benefit federally significant plant and animal species that include listed and proposed species, sensitive and at-risk species, migratory birds, anadromous fish and critical habitats for listed species (USFWS 1997). The ecological goals of the program are to restore ecosystem functions and values to natural conditions and achieve ecosystem restoration goals and objectives in concert with other governmental watershed restoration programs in the area affected by the Northwest Forest Plan. Additional program benefits and objectives include encouraging partners (e.g., government entities, private organizations and individuals) to promote environmental education experiences and to foster long-term stewardship of natural resources in the Pacific Northwest.

Watershed restoration efforts focus on 1) riparian and wetland habitat restoration, 2) upland and forest restoration including road treatments and improvements that contribute to decreased sedimentation of watersheds, 3) fish passage improvements, and 4) in-stream restoration improvements accompanied by riparian or upland restoration.

Funded projects must meet all applicable environmental regulations, including the National Environmental Policy Act, the Endangered Species Act, the National Historic Preservation Act, and the Clean Water Act before project work can begin.

B. Klamath Restoration Program

Klamath Basin Act: Public Law 99-552 was adopted by Congress on October 27, 1986, for the purpose of authorizing a 20-year long Federal-State cooperative Klamath River Basin

Roads were inventoried and erosion potentials determined from assessing stream crossings and landslides. After the assessments were completed, specific sites with the highest erosion potentials were identified as a high priority for treatment. The two projects in this biological assessment will focus treatments in the areas of highest priority identified in the watershed assessments.

III. DESCRIPTION OF PROPOSED ACTIONS

The biological assessment describes two watershed restoration projects in the McGarvey and South Fork Ah Pah Creek watersheds in Humboldt and Del Norte counties, California. The project areas are located on private land owned by Simpson Timber Company and some portions of Ah Pah Creek are also within Yurok Tribal lands. The USFWS, the Yurok Tribal Fisheries Program and Simpson Timber Company will cooperate to decrease sedimentation to both creeks from roads built to harvest timber.

A. Description of Project Areas

The project areas are located in two lower tributary watersheds of the Klamath River (Figure 1.) Work will be done in McGarvey and South Fork Ah Pah Creek watersheds. McGarvey Creek is located approximately 6.6 river miles from the mouth of the Klamath River. South Fork Ah Pah is approximately 17.3 river miles from the mouth of the Klamath River. The headwaters of these tributaries come together on the Newton Dewrey Bypass 25 miles south of Crescent City and 50 miles north of Eureka.

Streams within these project areas are typical of streams found in upland areas. Most are lower order, intermittent streams with relatively small drainage areas. Mainstem McGarvey Creek flows year round but is very low gradient and is inundated by the Klamath River in the lower reach. Ah Pah Creek is also very low gradient and runs subsurface in the lower reaches most of the summer.

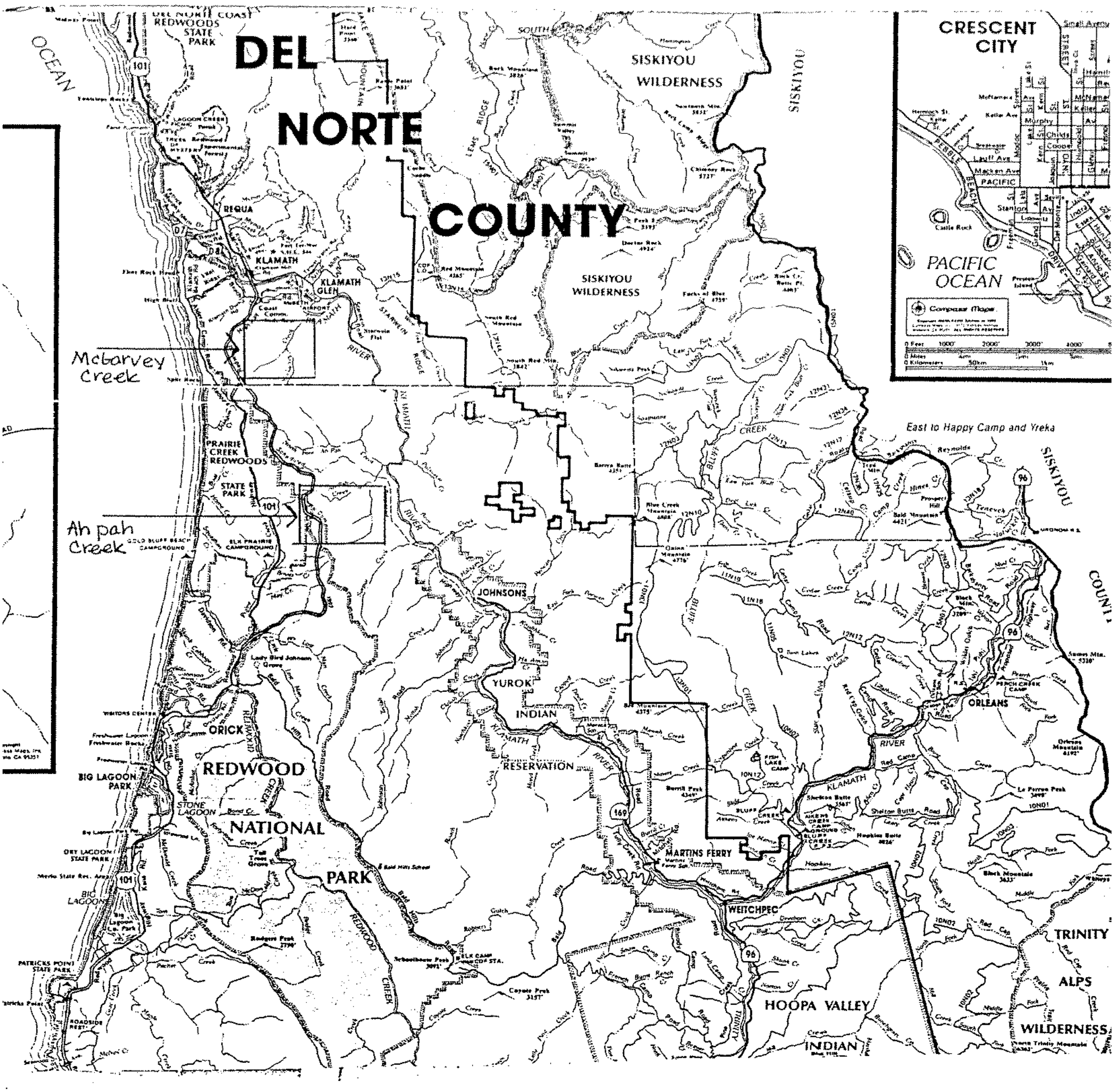
The McGarvey Creek Project Area

The McGarvey Creek project is located in the lower Klamath Basin within portions of the Townships 12 and 13 North and Ranges 1 and 2 East (Figures 2 and 3). This project includes the entire watershed drainage area (8.6 mi^2.) of McGarvey Creek. Elevations range from 60 ft. (mouth) to 800 ft. (headwaters) above sea level. McGarvey Creek was selected because it supports anadromous and resident fish populations and is considered to be a priority stream by both the Yurok Tribe and Simpson Timber.

The Ah Pah Creek Project Area

The Ah Pah Creek project area is located in the lower Klamath Basin within portions of Townships 12 N and Ranges 1 and 2 East (Figures 4 and 5). Elevations range from 80 to 1400 ft. above sea level. This project includes the total drainage area for both the mainstem and South Fork of Ah Pah Creek (3.5 mi^2.). Ah Pah Creek was selected because it supports anadromous and resident fish populations and is considered to be a priority stream by both the Yurok Tribe

Figure 1. McGarvey and Ah Pah Creek Watersheds.



gure 2. McGarvey Creek. Fern Canyon and Ah Pah
dge 7.5 min. Quadrangles

CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 ORICK 15' QUADRANGLE

DEPARTMENT
GEOLOG

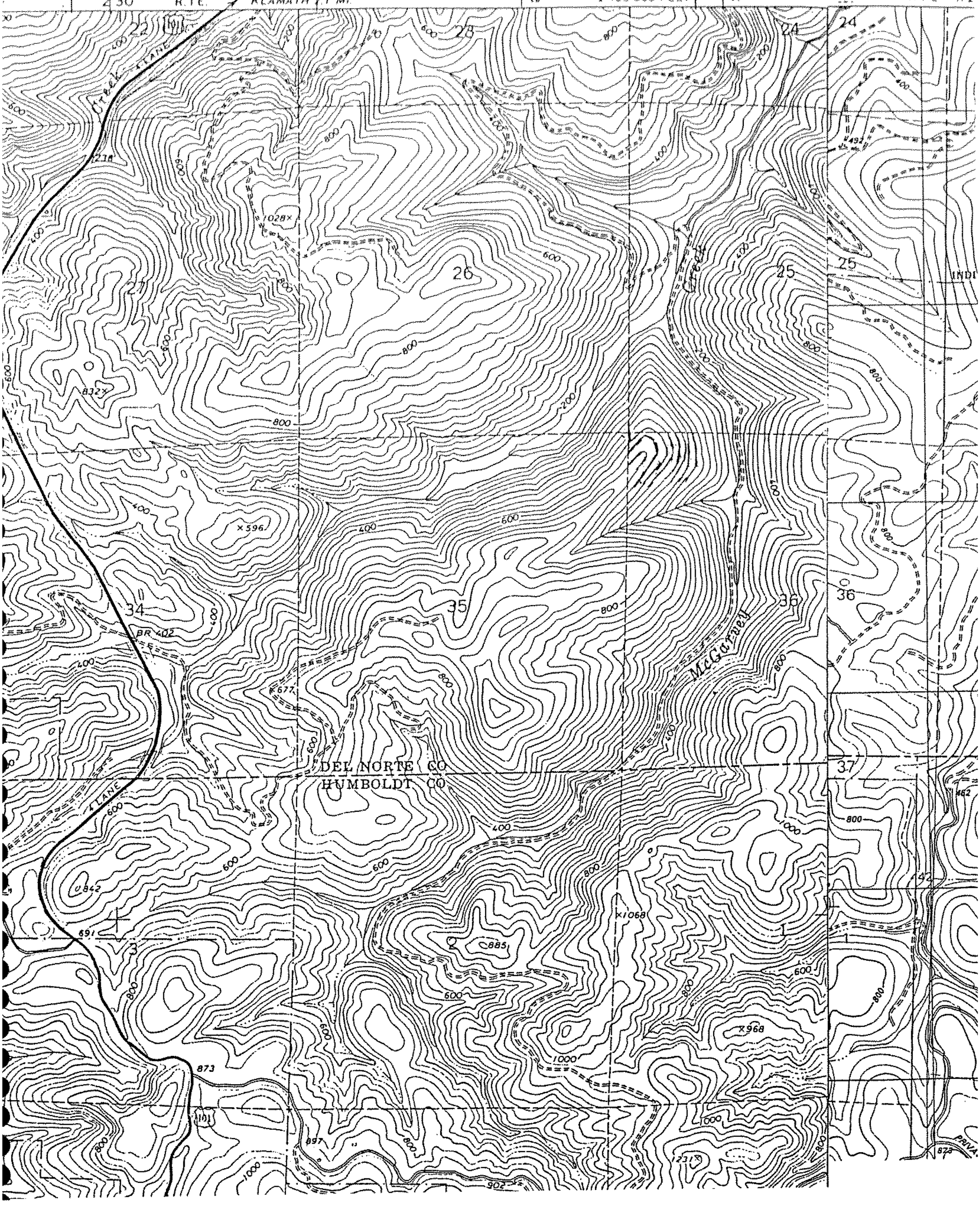
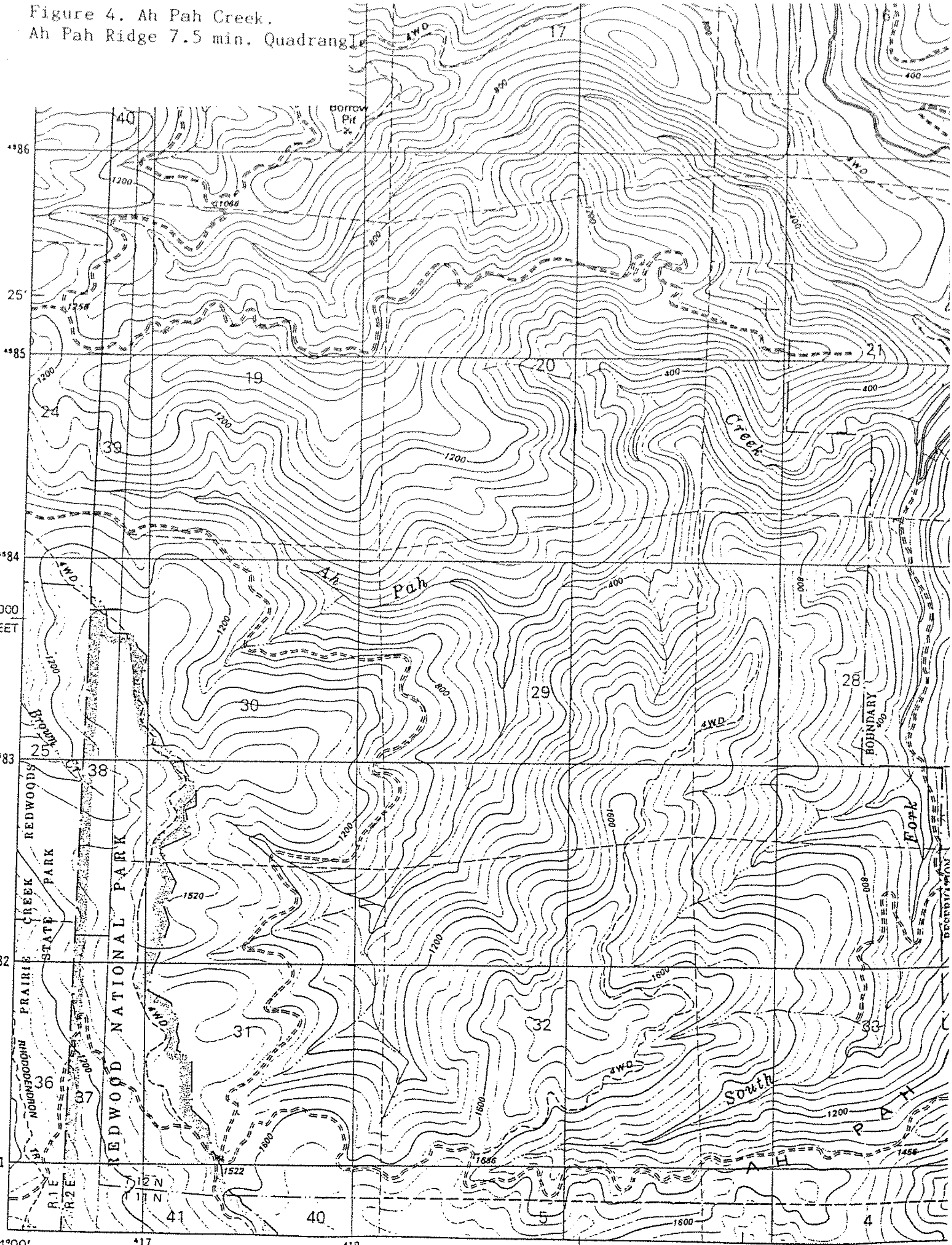


Figure 4. Ah Pah Creek.
Ah Pah Ridge 7.5 min. Quadrangle



Mapped, edited, and published by the Geological Survey
Control by USGS and NOS/NOAA

(ORICK) 1166 I SE

C. Project Description and Implementation

Assessments have been completed for both the McGarvey Creek and Ah Pah Creek watersheds, giving a detailed accounting of sediment input potential from all roads in the basins (Pacific Watershed Associates 1997; Yurok Tribe 1997). These documents indicate the McGarvey Creek watershed has a basin size of 8.6 square miles, with a road density of 7.3 miles per square mile, for a total of 63 miles of roads potentially to be treated. The erosion potential from these roads, and their associated stream crossing and landslides, is estimated to be 165,000 cubic yards of material. The South Fork of Ah Pah Creek basin is 3.5 square miles and contains 36 miles of road, for a density of 10 miles per square mile. The roads, and accompanying landslides and stream crossings, have an erosion potential of 83,733 cubic yards. Thus, there are 248,733 cubic yards of erosion potential from these two basins combined.

Implementation of the project will allow for treatment of a total of 120,049 cubic yards of erosion potential on 30 miles of roads, reducing the road associated erosion potential in the two basins combined by approximately 48%. Approximately 21 miles of roads will be treated in the McGarvey Creek drainage basin, which have a total erosion potential of 73,025 cubic yards. This area includes 77 stream crossings and 88 potential land slides. Most crossings have diversion potential and nearly all of the landslide sites are unstable road fills and log landings. About 9 miles of roads would be treated in the Ah Pah Creek drainage basin, which have a total erosion potential of 47,024 cubic yards. There are approximately 148 stream crossings and 61 potential fill failures. Most of these crossings have diversion potentials with the ability to erode an undermined volume of sediment from hill slopes. Combining both proposed projects, approximately 12 miles of roads would be upgraded to modern-day road standards and 18 miles would be decommissioned. Project work will begin in 1998 and is expected to be completed by the end of 1999.

Roads needed for long-term management will be upgraded to modern standards. Dead-end roads not needed in the immediate future and roads that cross highly unstable terrain will be decommissioned.

On upgraded roads, rolling dips would be used to drain road surfaces and inside ditches. Where road surfaces had been previously rocked, the rock would be scraped from the road surface, pushed aside, then reapplied over the completed rolling dip. Unstable fill along the outer edges of roads and landings, that could reach a stream if failure occurred, would be pulled back.

Two log jams will be modified in McGarvey Creek to provide improved passage for anadromous fish. Wood within the log jams will be moved using high line cables, grip hoists, chainsaws and possibly heavy equipment if necessary. Wood will remain in the stream channel but will be positioned to provide improved fish passage. Wood will be positioned taking care to minimize the sediment release that may occur from material trapped within or behind the log jam.

utilizing flex-pipe and straw bales.

- All mechanical equipment that will be used within the ordinary high water line shall be free of grease, oil, or other external petroleum products or lubricants while working around the creek. Equipment shall be thoroughly checked for leaks and any necessary repairs shall be completed prior to commencing work activities.
- No herbicides or insecticides will be used.

Monitoring

Terra Wave geologist David Bernson and staff will monitor project work during implementation to ensure work is completed according to cooperative agreements and contract specifications. After implementation, erosion treatments and log jam modifications will be monitored by the Yurok Tribe's watershed restoration geologists and staff by conducting site visits throughout the year, particularly during the winter months following large storms. Photo points will also be established at critical sites to create a photographic record of physical changes. Sediment transport trends in the McGarvey/South Fork Ah Pah Creek drainage basins will be monitored by repeat aerial photography. Stream channel changes will be monitored by repeat surveys of mainstream cross-sections and longitudinal profiles, and the quality of fish habitat and fish populations will be monitored by repeat habitat surveys performed by biologists of the Yurok Tribe's Fisheries Department.

Summary of Limited Operating Periods for Listed and Candidate Species

Coho salmon, chinook salmon, steelhead trout, sea run cutthroat trout: Heavy equipment work will occur during the summer months (June 1, 1998 - October 15, 1998) when rain is unlikely, streams have reached summer low flows or are dry, and spawning is unlikely to occur. Performing work during this time period will reduce potential impacts to anadromous fish.

IV. EXISTING ENVIRONMENT

Logging, mining, agriculture, stream channelization, and water diversion activities have all reduced the quantity and quality of fish spawning and rearing habitat and contributed to the decline of coho salmon, steelhead and other salmonid populations (USDC NMFS 1995, 1996, 1997a). The Ah Pah and McGarvey Creek watersheds have been intensively harvested for timber. Roads modify natural hillslope drainage networks and accelerate erosion processes. These changes alter physical processes in streams leading to changes in streamflow regimes, sediment transport and storage, channel bank and bed configurations, substrate composition, and stability of slopes adjacent to streams (USDA 1993).

1. Coho salmon (*Oncorhynchus kisutch*)
   Status: **Threatened** for Southern Oregon/Northern California Evolutionarily Significant Unit (ESU). The ESU extends from between Punta Gorda (CA) to Cape Blanco (OR).

Recent Survey Efforts

Trapping efforts on McGarvey Creek by the Yurok Tribe yielded 253 yearling and no young of the year (YOY) coho in 1997, during 89 days of trapping (weeks ending 3/29-6/21); 1998 efforts produced 147 yearling and 99 YOY coho during 86 days of trapping (weeks ending 3/14-6/6). The 1997 catch per unit effort (CPUE) was 5.87 yearling and 0 YOY fish per day, compared to 3.3 yearling and 0 YOY coho in Hunter Creek. In 1998 the CPUE for McGarvey Creek was 1.71 yearling and 1.15 YOY, while Hunter Creek had 2.14 yearling and 0 YOY coho (information supplied by Jim Craig, USFWS, Arcata, via Yurok Tribal Fisheries Program). The YOY coho index for 1998 may largely be a weather based anomaly, since all 99 fish were trapped while heavy rains contributed to increasing river flows from about 13,000 to over 70,000 cfs (Jim Craig, pers. comm.).

Juvenile trapping efforts conducted on Ah Pah Creek by the USFWS in 1989 resulted in only 1 coho being sampled per day for 12 days (USDI 1990). By 1991, juvenile coho trapping rates increased to 5.5 fish per day, however, trapping efforts were halted early (5/29) in the 1989 season because of personnel constraints (USDI 1990), so the data may not be comparable. Juvenile coho had two separate peaks in Ah Pah Creek during outmigrant trapping in 1991, with the first peak occurring in late March to mid-April, and the second peak in late May through early June (USDI 1992). Early cessation of trapping efforts in 1989 may have significantly affected the sample results. Spawning surveys identified two coho (one male and one female), approximately 1.25 miles from the mouth of the creek on November 29, 1990, but no redds were found at this time (J. Schwabe, CDFG, from USDI 1992). On December 14, 1990 six redds were observed between 1 and 2 miles upstream of the mouth, along with four adult steelhead, one coho jack and one coho carcass in the same section of the creek.

B. Habitat Status

Critical habitat for the southern Oregon/northern California coho salmon ESU was proposed by NMFS on November 25, 1997 (62 FR 62741). The critical habitat encompasses accessible reaches of all rivers between the Mattole River in California and the Elk River in Oregon, and includes riparian zones within 300 feet from the normal line of the high water stream channel (defined as bankfull width - G. Bryant, pers. comm.) or adjacent off-channel habitats. Essential features of coho critical salmon critical habitat include adequate: 1) substrate, 2) water quality, 3) water quantity, 4) water temperature, 5) water velocity, 6) cover/shelter, 7) food, 8) riparian vegetation, 9) space, and 10) safe passage conditions (USDC NMFS1997 b).

Specific habitat components important for coho salmon fry are in-stream habitat complexity, including a mixture of pools and riffles, large woody debris, and well oxygenated cool water, with preferred temperatures ranging from 50-59°F(10-15°C) (Reiser and Bjornn 1979). Coho fry initially congregate in quiet backwaters, side channels and small creeks, especially in shady areas with overhanging branches. As they grow, they move to more open waters, but are unable to compete with chinook fingerlings in defending preferred open water sites (Sandercock 1991). More structurally complex streams support larger numbers of fry.

run fish which have delayed outmigration because Ah Pah Creek frequently goes subsurface near its mouth by late spring (USDI 1990). Only one chinook fry and one chinook yearling were trapped in Ah Pah Creek during the 1989 sampling season, but none were trapped in 1991 (USDI 1990, 1992). An early end to the 1989 sampling season may have affected results in Ah Pah Creek. The total number of chinook trapped in all Klamath tributaries has declined from 247 to 7 between 1989 and 1991 (USDI 1992).

Yurok Tribe sampling efforts produced 30 chinook from McGarvey Creek in 1997 and 1 in 1998. McGarvey Creek CPUE was 0.33 fish per day in 1997 and less than 0.01 fish per day in 1998, compared to 4.4 fish per day in 1997 and 18.24 fish per day (1998) for Hunter Creek (Yurok Tribe data, Jim Craig, pers. comm.). McGarvey Creek was not among the tributaries sampled by USFWS (USDI 1992).

B. Habitat Status

Critical habitat for the southern Oregon and coastal California chinook salmon ESU was proposed by NMFS on March 9, 1998 (50 CFR parts 222, 226, 227). Essential features of chinook salmon critical habitat are the same features identified for coho salmon in the previous section. Within the proposed rule for critical habitat, NMFS states that "habitat loss and/or degradation is widespread throughout the range of the ESU" and that almost all populations south of the Klamath River are extremely depressed, especially spring-run populations. The California Department of Fish and Game (1965, Vol. III, Part B, as cited in USDC, NOAA50 CFR, parts 222, 226, 227 1998) reported the most vital factor for California streams as being "degradation due to improper logging, followed by massive siltation, log jams, etc."

A habitat assessment was conducted by the USFWS in 1989 and 1991 on Ah Pah Creek. Spawning habitat was classified as embedded and in poor condition in the USDI 1992 report. Rearing habitat was considered to be in moderate condition. USFWS did not type habitat in McGarvey Creek and we were unable to locate a source of information for such data.

3. Steelhead Trout (*Oncorhynchus mykiss*)
Status: **Candidate** Klamath Mountains Province ESU.
The ESU extends from the Elk River in Oregon to the Klamath and Trinity Rivers in California.

A. Species Account

Steelhead trout exhibit various life history strategies. They typically migrate to the ocean after spending 2 years in freshwater, then reside in the ocean for 2 to 3 years, prior to returning to their natal stream to spawn as 4 or 5 year olds (USDC NMFS 1996). Most steelhead in California spawn from December through April, but some runs may spawn into the early summer months (McEwan et al. 1996). Steelhead are iteroparous, however it is rare for them to spawn more than twice before dying (USDC NMFS 1996). Steelhead exhibit seasonal peaks in migration that are used to identify various runs. (Busby et al. 1994). Two different runs of steelhead represent separate reproductive types identified as the "stream maturing" type and the "ocean maturing"

In the Klamath River system, logging, mining, agriculture, the construction and management of hydroelectric dams and other water diversions, have all contributed to the decline of steelhead populations within the ESU (USDC NMFS 1995). These activities have contributed to habitat loss and degradation for steelhead and other anadromous salmonids (Busby et al. 1994, USDC NMFS 1995). Droughts, floods, ocean conditions such as periodic warm ocean temperatures (El Nino), and other natural environmental conditions. also impact steelhead populations that are already in decline.

The current distribution of steelhead extends from the Kamchatka Peninsula, east and south along the Pacific coast of North America, to at least Malibu Creek in southern California (USDC NMFS 1996). Total abundance of steelhead within the ESU, including hatchery produced fish, varies, with many populations having runs of 10,000 fish or more (Busby et al. 1994). Steelhead populations on the Klamath River, the majority of which are hatchery produced fish, may total 100,000 or more per year whereas many populations have less than 1,000 fish per year (Busby et al. 1994). Quantitative information regarding populations of naturally reproducing steelhead is scarce.

Recent Survey Efforts
In 1989 through 1991, the Service conducted trapping efforts for juvenile salmonids on several lower Klamath River tributaries. Yearling steelhead were captured in low numbers in Ah Pah Creek during both 1989 and 1991, the only two years this creek was sampled by the USFWS. No steelhead fry were captured in either year (USDI 1990, 1992). The occurrence of greater numbers of yearlings than fry may be explained by the mouth of Ah Pah Creek going subsurface in late spring, since several other creeks in this watershed have this feature and also have more yearling than fry sampled. Yurok Tribe sampling of McGarvey Creek produced 1,058 steelhead parr/smolts and 27 steelhead YOY in 89 days of sampling during 1997. This compares to 1,770 steelhead parr/smolts and 156 YOY in 76 days of sampling on Hunter Creek during 1997, using the same type of trap, during the same time period. In 1998, 738 parr/smolts and 719 YOY were trapped in McGarvey Creek, compared to 971 and 165, respectively, for Hunter Creek (Yurok Tribe data, as provided by Jim Craig).

B. Habitat Status
Habitat assessment surveys for the creek showed that substrate embeddedness progressively increased towards the headwaters, reaching greater than 75% embeddedness. Anadromous fish migrations were blocked by a log jam approximately 4 miles upstream (USDI 1992). Streambank stability and riparian cover was described as good in most of the creek, but spawning and rearing habitat were only rated fair to moderate. These conditions, along with the seasonal migration barrier caused when the lower 5000 feet of the creek goes subsurface in the late spring, may limit the productivity of Ah Pah creek to most salmonid species. As noted above, McGarvey Creek was not assessed by USFWS.

5. Sea run Cutthroat Trout (*Oncorhynchus clarki clarki*)
Status: **Candidate**

period during, and immediately afterwards, when there may be effects that would be considered adverse to species within the project area. The short-term adverse effects often result from the necessary movement of substrate and/or vegetation. The long-term affects of the project are intended to benefit the habitat, and ultimately, the species. As a part of the cooperative restoration effort, the landowners have agreed in writing to work in a partnership to maintain the integrity of all improvements for a period of 10 years.

Coho salmon, chinook salmon, steelhead trout, sea run cutthroat and proposed critical habitat for coho and chinook salmon:

1. Direct Effects: Project work will occur along the creeks and along small tributaries and springs that enter the main creek channels. Direct effects could occur to fish downstream of project work sites, due to short-term increases in turbidity, if water is flowing when stream crossings are being treated. Increased turbidity may last 4 - 6 hours from soil disturbance at stream crossings when culverts are removed or replaced. Some portions of streams may be intermittent where project work will occur. Other direct effects will be a decrease in the erosion potentials of numerous sediment sources.

2. Indirect Effects: Short-term indirect effects may occur from stream crossings removed on decommissioned roads. On average, approximately 5 cubic yards of sediment may erode from each freshly excavated stream channel during the first winter season. Sediment concentrations, immediately adjacent to the work sites might increase temporarily, but would decrease after the first large winter storm when the channels would adjust to their new form. Sediment volumes would be small, dispersed over a large area, and expected erosion potential would be much less than if these crossings were left in place, or untreated.

Long-term beneficial effects to the riparian area would occur. Riparian areas would become more stable because the potential for landslides, which can damage these areas instantaneously, would be greatly reduced. Benefits of a stable riparian area include: maintenance of cool water temperatures needed by fish; creation of stream channel and bank stability to maintain suitable habitat for fish and other aquatic organisms; and provision of nutrients for aquatic organisms and fish. Riparian vegetation provides a source of large woody debris that maintains channel complexity required by fish for spawning and rearing, and buffers water quality from pollutants, including sediment, entering a stream from runoff. Providing these components of the aquatic environment can have important impacts on the health of the watershed in the immediate area of the project work, but are likely to be overshadowed, at the larger watershed scale (Klamath River), by the extensive road network on private lands in need of similar work.

Project work will provide long-term benefits to some of the essential features of critical habitat proposed for coho and chinook salmon, including water quality and riparian vegetation. The recurring loss of salmonid habitat from upslope erosion from roads will be reduced and habitat quality may improve in the creeks. Thus, survival of juvenile fish that reside in these fresh water habitats, before migrating to the sea, may increase in time. Maintenance of erosion treatments

TABLE 1. CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PATHWAYS: INDICATORS	ENVIRONMENTAL BASELINE			EFFECTS OF THE ACTION(S)		
	Properly Functioning[1]	At Risk[1]	Not Propr. Functioning[1]	Restore[2]	Maintain[3]	Degrade[4]
Water Quality: Temperature	N/D				X	
Sediment	N/D		X-upslope erosion sources have been identified		X	
Chem. Contam./Nut.	N/D				X - Lower Klamath included in CWA 303d TMDL priority list	
Habitat Access: Physical Barriers			X - Instream log jams at rkm 4.9, 5.5 & 6.75, log jam at rkm 6.75 is end of andromony on Ah Pah Creek. Two instream log jams identified on McGarvey Creek		X	
Habitat Elements: Substrate			X - Spawning reaches embedded & in poor condition, adequate substrate exists	X - reducing sediment loads should improve embedded condition.		
Large Woody Debris	X - LWD averages 18/ rkm instream & 25 recruitable/ rkm				X	
Pool Frequency	X - 38 pools/ rkm				X - may improve pool quality and frequency.	
Pool Quality		X - pool depth avg 0.7 ft, embedded 25%-75%			X	

Water Quality Note: No data available for McGarvey Creek.
Temperature: Temperature data not available.

Sediment: Turbidity measurements were unavailable and it is not known whether such measurements have ever been made. The stream bed does include fine sediment and sediment regularly enters the stream as a result of stream bank erosion. Project work may begin the process of moving the environmental baseline from "not properly functioning" to "at risk".

Chemical or nutrient contamination: Measurements have not been made to quantify the level of contamination. The watershed is included as part of the Lower Klamath River system as identified in the CWA 303d TMDL priority list for California (Table 2).

Habitat Access Note: No data available for McGarvey Creek
Physical Barriers: Anadromous fish migrations end at approximately 4 miles from the mouth where a log jam clogs the channel, elevating the streambed over 20 feet (USDI 1992). Other log jams were present downstream, but salmonid fry were observed above both these potential barriers.

Habitat Elements Note: Minimal data available for McGarvey Creek.
Substrate: Spawning reaches of Ah Pah Creek were embedded and in poor condition, but rearing conditions were rated as moderate (USDI 1992). The embeddedness of this creek appears to be the primary spawning hindrance, as classifications of channel type show suitable substrate is present. Three reaches were classified according to he Rosgen Stream Classification system, as B3, characterized by a cobble bed with a mixture of gravel and sand, and some small boulders. C3, the second most dominant channel type, consists of a gravel bed with small cobble and sand.

Large Woody Debris: Large Woody Debris averaged 18 pieces instream and 25 recruitable per river kilometer of Ah Pah Creek up to river kilometer 6.5, just before the end of andromony. (USDI 1992). Most conifers that existed along the creeks have been harvested and hardwoods are the dominate trees adjacent to the creeks. Therefore, natural recruitment of woody debris to the creeks would likely be hardwoods at this time.

Pool Frequency: There were an average of 38 pools per river kilometer of Ah Pah Creek (USDI 1992).

Pool Quality: Pool depth measurements averaged 0.7 feet (USDI 1991) and embeddedness ranged from 25-75% in most reaches. The substrate was a mixture of gravel, sand, and cobble in virtually all reaches (USDI 1992).

Off-channel Habitat: Off-channel habitat exists in the mainstem of Ah Pah Creek at river kilometer 5.4, where a tributary enters the stream (USDI 1992). Several small tributary streams drain into Ah Pah and McGarvey Creeks with the potential to provide off-channel habitat.

VI. DETERMINATION

Coho salmon (Threatened)

Likely to Adversely Affect:

Ah Pah and McGarvey creeks historically supported coho salmon. Results from sampling efforts conducted by the Service in 1989 and 1991 show that coho continue to use Ah Pah Creek. McGarvey Creek sampling shows coho yearlings were trapped in 1997 and 1998 and YOY were trapped in 1998, but not 1997. Watershed restoration efforts will likely cause short-term increases in turbidity to the creeks. The potential short-term adverse affects will be of short duration and are a part of an overall restoration effort with short and long-term benefits to improve habitat for the species by providing improved instream habitat and decreasing sedimentation. Project work will occur between June 1st and October 15th to decrease the potential for short term increases in turbidity to adversely affect the species. We conclude that the proposed action may affect and is likely to adversely affect the coho salmon. We request authorization of take, as specified in Section 10(a)(1) of the Endangered Species Act, if National Marine Fisheries Service believes such authorization is required for the projects.

Chinook salmon (Proposed Threatened)

Not Likely to Jeopardize the Continued Existence of the Species:

Ah Pah and McGarvey creeks historically supported chinook salmon. Results from sampling efforts conducted by USFWS in 1989 and 1991 show that chinook continued to use Ah Pah Creek in 1989, but none were found in 1991. McGarvey Creek sampling captured 30 chinook in 1997, but only one in 1998. Project work will not directly or indirectly reduce appreciably the likelihood of both the survival and recovery of the species in the wild. The projects are a part of an overall restoration effort with short and long-term benefits to improve habitat for the species by providing improved instream habitat and decreasing sedimentation of streams. We conclude that the two projects are not likely to jeopardize the continued existence of the species. In the event the species is listed before project implementation is complete, we will request adoption of the conference opinion as a biological opinion.

Steelhead trout (Candidate)

Not Likely to Jeopardize the Continued Existence of the Species:

Ah Pah and McGarvey creeks historically supported steelhead trout. Current results from sampling efforts conducted by the Service in 1989 and 1991 show that steelhead continue to use Ah Pah Creek. McGarvey Creek sampling produced substantial numbers of steelhead parr/smolts in both 1997 and 1998 and substantial numbers of young of the year in 1998, but far fewer young of the year in 1997. Project work will not directly or indirectly reduce appreciably the likelihood of both the survival and recovery of the species in the wild. The projects are a part of an overall restoration effort with short and long-term benefits to improve habitat for the species by decreasing sedimentation of streams. We conclude that the two projects are not likely to jeopardize the continued existence of the species.

modification of, proposed critical habitat. In the event proposed critical habitat is listed before project implementation is complete, we will request adoption of the conference opinion as a biological opinion.

VII. MANAGEMENT RECOMMENDATIONS

There are no management recommendations.

VIII. LITERATURE CITED

Brown, L. R., P. B. Moyle, and R. M. Yashiyama. 1994. Historical decline and current status of coho salmon in California, N. Am. J. Fish Mgt. 14(2): 237-261.

Burgner, R. L., J. T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito. 1992. Distribution and origins of steelhead trout (Oncorhynchus mykiss) in offshore waters of the North Pacific Ocean. Int. North Pac. Fish. Comm. Bull. 51, 92 p.

Busby, P. J., T. C. Wainwright, and R. S. Waples. 1994. Status review for Klamath Mountains Province steelhead. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-NWFSC-19, 130 p.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. Lierheimer, R. S. Waples, F.W. Waknitz, and I. V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-27, 261 p.

California Department of Fish and Game (CDFG). 1994. Petition to the California Board of Forestry to list coho salmon (*Oncorhynchus kisutch*) as a sensitive species. Calif. Dep. Fish Game Rep., 35 p. plus appendices.

Everest, F. H. 1973. Ecology and management of summer steelhead in the Rogue River. Oregon State Game Comm., Fishery Research Report 7, Corvallis, 48 p.

Groot C. and L. Margolis. 1991. Pacific Salmon Life Histories. UBC press. 564 p.

Klamath River Basin Fisheries Task Force (KRBFTF). 1991. Long range plan for the Klamath River Basin Conservation Area Fishery Restoration Program, 339 p. plus appendices.

McEwan, D. and T. A. Jackson. 1996. Steelhead restoration and management plan for California. California Dept. of Fish and Game, 234 p.

Moyle, P. B. 1976. Inland Fishes of California. University of California Press, Berkeley, CA, 405 p.

spotted owl (ROD).

USDA Forest Service, USDI Bureau of Land Management. 1994b. Final supplemental environmental impact statement on management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl (FSEIS). Volumes I & II.

USDC, NMFS. 1995. Endangered and threatened species; proposed threatened status for southern Oregon and northern California steelhead. Federal Register, 60(51):14253-14261.

USDC, NMFS. 1996. Endangered and threatened species; proposed endangered status for five ESUs of steelhead and proposed threatened status for five ESUs of steelhead in Washington, Oregon, Idaho, and California. Federal Register, 61(155):41541-41561.

USDC, NMFS. 1997a. Endangered and threatened species; threatened status for Oregon/Northern California coast Evolutionarily Significant Unit (ESU) of coho salmon. Federal Register, 62(87):24588-24609.

USDC, NMFS 1997b. Designated critical habitat; central California coast and southern Oregon/northern California coast coho salmon. Federal Register, 62(227):62741-62751.

USDC, NMFS 1998. Endangered and threatened species; west coast chinook; listing status change; proposed rule. Federal Register, 63(45):11481-11520.

USDI, U.S. Fish and Wildlife Service. 1979. Inventory of reservation waters, fish rearing feasibility study and a review of the history and status of anadromous fishery resources of the Klamath River Basin. Final Report, 240 p.

USDI, U. S. Fish and Wildlife Service. 1990. Investigations on the lower tributaries to the Klamath River, Klamath River fisheries assessment program. Annual Progress Report FY 1989. Fisheries Assistance Office, Arcata, CA, 36 p.

USDI, U. S. Fish and Wildlife Service. 1992. Investigations on the lower tributaries to the Klamath River, Klamath River fisheries assessment program. Annual Progress Report FY 1990, 1991. Coastal California Fishery Resource Office, Arcata, CA, 82 p., 57 p.

Weitkamp, L.A., T. C.Wainwright, G. J. Bryant, G. B. Milner, D. J. Teel, R. G. Kope, and R. S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-24, 258 pp.

Yurok Tribe. 1997. South Fork Ah Pah Creek Watershed Assessment Report. Prepared for NEAP and the Humboldt County RCD, 43 p.

APPENDIX B: Roads Survey Data

McGarvey Creek Watershed:

Table 3: PRE/POST-WORK DONE ON THE *M-1000* (SUMMER OF 1998)

Site #	RX #	Site Type	Past Erosion (yd^3)	Pre-work (yd^3)	Post-work (yd^3)	% difference
310		LANDSLIDE		1226	1226	0%
311	RX 7	STREAM CROSSING	1	528	130	75%
312	RX 6	STREAM CROSSING		819	169	79%
313		LANDSLIDE		4148	4148	0%
314	RX 5	STREAM CROSSING		1553	952	39%
315	RX 4	STREAM CROSSING	5	776	363	53%
316		LANDSLIDE		704	704	0%
317		LANDSLIDE		1380	1380	0%
318	RX 3	STREAM CROSSING	179	2253	534	76%
319	RX 2	STREAM CROSSING	21	642	736	13%
320		LANDSLIDE		1667	1667	0%
321		LANDSLIDE		671	671	0%
322	RX 1	STREAM CROSSING		669	850	21%
323		LANDSLIDE		4167	4167	0%
		TOTALS:	**206**	**21203**	**17697**	**17%**

Table 4: PRE/POST WORK DONE ON THE *M-800* (SUMMER OF 1998)

Site #	RX #	Site Type	Past Erosion (yd^3)	Pre-work (yd^3)	Post-work (yd^3)	% diff.	Notes
210	RX 20	STREAM CROSSING	19	55	55	0%	BRIDGE
211	RX 19	STREAM CROSSING	2	372	218	41%	
212		LANDSLIDE		405	405	0%	
213	RX 18	STREAM CROSSING		340	412	17%	
214		LANDSLIDE		750	750	0%	
215		LANDSLIDE		230	230	0%	
216	RX 17	STREAM CROSSING	2	409	184	55%	
217		LANDSLIDE		111	111	0%	
219		LANDSLIDE		420	420	0%	
220		LANDSLIDE		167	167	0%	
221	RX 16	STREAM CROSSING	1	196	241	19%	
222	RX 15	STREAM CROSSING	0	387	692	44%	
223	RX 14	STREAM CROSSING	54	274	632	57%	
224		LANDSLIDE		289	289	0%	
225		LANDSLIDE		177	177	0%	
226		LANDSLIDE	600	130	130	0%	
227		LANDSLIDE		150	150	0%	

228		LANDSLIDE		228	228	0%	
229		LANDSLIDE		180	180	0%	
230	RX 13	STREAM CROSSING		171	94	45%	
NEW	RX 12	NEW			XRD	0%	
231		LANDSLIDE		144	144	0%	
232	RX 11	STREAM CROSSING	342	478	344	28%	
233		LANDSLIDE		1453	1453	0%	
234		LANDSLIDE		474	474	0%	
235	RX 10	STREAM CROSSING	3	163	377	57%	
236		LANDSLIDE		240	240	0%	
237	RX 9	STREAM CROSSING	53	986	261	74%	
238	RX 8	STREAM CROSSING		222	393	44%	
239		LANDSLIDE		1018	1018	0%	
240		LANDSLIDE		1140	1140	0%	
241	RX 7	STREAM CROSSING	1500	200	128	36%	
242		LANDSLIDE		431	431	0%	
243	RX 6	STREAM CROSSING		86	86	0%	
244		LANDSLIDE		567	567	0%	
245		NEW			XRD	0%	
246		LANDSLIDE		383	383	0%	
247	RX 5	STREAM CROSSING		156	556	72%	
248	RX 4	STREAM CROSSING	13	76	448	83%	
249		LANDSLIDE		48	48	0%	
250		LANDSLIDE		462	462	0%	
251		STREAM CROSSING	77	68	68	0%	BRIDGE
252		LANDSLIDE		149	149	0%	
253	RX 3	STREAM CROSSING	25	282	683	59%	
275		LANDSLIDE		833	833	0%	
276		LANDSLIDE		625	625	0%	
277	RX 2	STREAM CROSSING		47	27	43%	
278		LANDSLIDE	28	666	666	0%	
279	RX 1	STREAM CROSSING	6	111	314	65%	
280		STREAM CROSSING		D/D		0%	
281		LANDSLIDE		D/D		0%	
		TOTALS:	**1375**	**16949**	**18083**	**6%**	

Table 5: PRE/POST WORK DONE ON THE *M-800 SPURS*
(SUMMER OF 1998)

Road Name	Site #	RX #	Site Type	Past Erosion (yd^3)	Pre-work (yd^3)	Post-work (yd^3)	% diff.
M-805	1	RX 1	STREAM CROSSING	0	NA	708	0%
M-805	2	RX 2	STREAM CROSSING	0	NA	577	0%
			TOTALS:	**0**	**0**	**1285**	**0%**
Road Name	**Site #**	**RX #**	**Site Type**	**Past Erosion (yd^3)**	**Pre-work (yd^3)**	**Post-work (yd^3)**	**% diff.**
M-810	400	RX 1	STREAM CROSSING	0	866	189	78%
M-810	401	RX 2	STREAM CROSSING	139	786	280	64%
M-810	402		LANDSLIDE	0	259	259	0%
			TOTALS:	**139**	**1911**	**728**	**62%**
Road Name	**Site #**	**RX #**	**Site Type**	**Past Erosion**	**Pre-work**	**Post-work**	**% diff.**
M-820	254		STREAM CROSSING	0	49	XRD	0%
M-820	254.5	RX 2	STREAM CROSSING	156	1671	1528	9%
M-820	254.6		LANDSLIDE	0	105	105	0%
M-820	255		LANDSLIDE	0	602	602	0%
M-820	NEW SITE	RX 1	STREAM CROSSING	0	1740	1655	5%
			TOTALS:	**156**	**4167**	**3890**	**7%**
Road Name	**Site #**	**RX #**	**Site Type**	**Past Erosion**	**Pre-work**	**Post-work**	**% diff.**
M-830	258	RX 1	STREAM CROSSING	98	20	477	96%
M-830	259		LANDSLIDE	0	569	569	0%
M-830	260	RX 2	STREAM CROSSING	7	1048	1255	16%
M-830	261		LANDSLIDE	0	361	361	0%
M-830	262		LANDSLIDE	0	115	115	0%
M-830	263		LANDSLIDE	0	647	647	0%
M-830	264	RX 3	STREAM CROSSING	148	467	196	58%
M-830	265		LANDSLIDE	0	500	500	0%
M-830	266		LANDSLIDE	0	233	233	0%

M-830	267	RX 4	STREAM CROSSING	3	140	XRD	0%
M-830	268	RX 5	STREAM CROSSING	9	241	XRD	0%
M-830	269		LANDSLIDE	0	850	850	0%
M-820	270		LANDSLIDE	0	222	222	0%
M-830	271		LANDSLIDE	0	481	481	0%
M-830	272		LANDSLIDE	0	148	148	0%
M-830	273	RX 7	STREAM CROSSING	20	940	349	63%
M-830	274	RX 8	STREAM CROSSING	0	540	141	74%
			TOTALS:	**285**	**7522**	**6544**	**13%**

Table 6: PRE/POST WORK DONE ON THE *M-400*
(SUMMER OF 1998)

Site #	RX #	Site Type	Past Erosion (yd^3)	Pre-work (yd^3)	Post-work (yd^3)	% diff.
201	RX 4	STREAM CROSSING	5	1866	915	51%
201.5		LANDSLIDE	0	1178	1178	0%
202	RX 3	STREAM CROSSING	2	1047	1210	13%
203		LANDSLIDE	0	567	567	0%
204	RX 2	STREAM CROSSING	10	2658	4147	36%
205	RX 1	STREAM CROSSING	221	1957	672	66%
206	RX 1	STREAM CROSSING	0	1767	1017	42%
NEW	1	STREAM CROSSING	0	3465	3151	9%
NEW	2	STREAM CROSSING	0	876	553	37%
		TOTALS:	**238**	**15381**	**13410**	**13%**

Table 7: PRE/POST WORK DONE ON THE *OLD M-10 SOUTH* (SUMMER OF 1998)

Site #	RX #	Site Type	Past Erosion (yd^3)	Pre-work (yd^3)	Post-work (yd^3)	% diff.
147	RX 1	STREAM CROSSING	244	74	XRD	0%
148		LANDSLIDE	0	104	104	0%
149		LANDSLIDE	33	235	235	0%
150	RX 1	STREAM CROSSING	481	125	376	67%
151		LANDSLIDE	0	306	306	0%
152		LANDSLIDE	0	415	415	0%
153		LANDSLIDE	0	86	86	0%
154		LANDSLIDE	0	69	69	0%
155		LANDSLIDE	0	667	667	0%
156	RX 2	STREAM CROSSING	0	83	26	69%
157		STREAM CROSSING	0	70	XRD	0%
158		LANDSLIDE	0	511	511	0%
159		LANDSLIDE	0	733	733	0%
160		LANDSLIDE	0	567	567	0%
161		STREAM CROSSING	0	43	XRD	0%
162		LANDSLIDE	0	76	76	0%
163	RX 3	STREAM CROSSING	122	247	281	12%
164		LANDSLIDE	0	111	111	0%
		TOTALS:	**880**	**4522**	**4563**	**1%**

Table 8: PRE/POST WORK DONE ON THE *OLD M-10 NORTH* (SUMMER OF 1998)

Site #	RX #	Site Type	Past Erosion (yd^3)	Pre-work (yd^3)	Post-work (yd^3)	% diff.
121	RX 8	STREAM CROSSING	0	151	XRD	0%
122		LANDSLIDE	0	166	166	0%
123		LANDSLIDE	0	89	89	0%
124	RX 7	STREAM CROSSING	7	29	XRD	0%
125	RX 6	STREAM CROSSING	69	140	471	70%
126	RX 5	STREAM CROSSING	0	114	124	8%
127	RX 4	STREAM CROSSING	13	24	130	82%
128		LANDSLIDE	0	157	157	0%
129		LANDSLIDE	0	258	258	0%
130		OTHER	0	XRD	XRD	0%
131	RX 3	STREAM CROSSING	0	259	521	50%
132		LANDSLIDE	0	78	78	0%
133	RX 2	STREAM CROSSING	4	163	BRIDGE	0%
134		LANDSLIDE	0	178	178	0%
135	RX 1	STREAM CROSSING	0	22	29	24%
		TOTALS:	**93**	**1828**	**2201**	**17%**

Ah Pah Creek Watershed:

Table 9: PRE/POST WORK DONE ON THE *B-1100*
(SUMMER OF 1998)

Road Name	Site #	RX #	Site Type	Past Erosion (yd^3)	Pre-work (yd^3)	Post-work (yd^3)	% diff.
B-1100	9	RX 10	FLUVIAL EROSION	275	1009	1009	0%
B-1100	10		MASS MOVEMENT	0	106	106	0%
B-1100	11		MASS MOVEMENT	0	187	187	0%
B-1100	12	RX 9	FLUVIAL EROSION	11	318	460	31%
B-1100	13		MASS MOVEMENT	0	867	867	0%
B-1100	14		MASS MOVEMENT	667	0	0	0%
B-1100	15		FLUVIAL EROSION	0	18	XRD	0%
B-1100	16		MASS MOVEMENT	0	478	478	0%
B-1100	17		MASS MOVEMENT	241	0	0	0%
B-1100	18	RX 8	FLUVIAL EROSION	177	689	370	46%
B-1100	19		MASS MOVEMENT	148	56	56	0%
B-1100	20		MASS MOVEMENT	0	148	148	0%
B-1100	21		FLUVIAL EROSION	43	23	XRD	0%
B-1100	22	RX 7	FLUVIAL EROSION	0	22	62	65%
B-1100	23		MASS MOVEMENT	0	133	133	0%
B-1100	24		MASS MOVEMENT	0	192	192	0%
B-1100	25		FLUVIAL EROSION	216	23	XRD	0%
B-1100	26		FLUVIAL EROSION	0	172	XRD	0%
B-1100	27	RX 6	FLUVIAL EROSION	164	0	0	BRIDGE
B-1100	28		MASS MOVEMENT	185	0	0	0%
B-1100	29		MASS MOVEMENT	87	132	132	0%
B-1100	30		FLUVIAL EROSION	0	20	XRD	0%
B-1100	31	RX 5	FLUVIAL EROSION	33	117	126	7%
B-1100	32		MASS MOVEMENT	667	0	0	0%
B-1100	33	RX 4	FLUVIAL EROSION	24	265	143	46%
B-1100	34	RX 3	FLUVIAL EROSION	139	0	0	FORD
B-1100	35	RX 2	FLUVIAL EROSION	0	14	33	58%
B-1100	36		MASS MOVEMENT	193	1852	1852	0%
B-1100	37	RX 1	FLUVIAL EROSION	86	394	245	38%
B-1100	38		MASS MOVEMENT	133	33	33	0%
B-1100	39		FLUVIAL EROSION	0	5	XRD	0%
B-1100	40		MASS MOVEMENT	0	113	113	0%
			TOTALS:	3489	7386	6745	9%

Table 10: PRE/POST WORK DONE ON THE *B-1070*
(SUMMER OF 1998)

Road Name	Site #	RX #	Site Type	Past Erosion (yd^3)	Pre-work (yd^3)	Post-work (yd^3)	% diff.
B-1070	1	1	FLUVIAL EROSION	0	33	XRD	NA
B-1070	2	2	FLUVIAL EROSION	0	251	258	3%
B-1070	3	3	FLUVIAL EROSION	27	184	457	60%
B-1070	4	4	FLUVIAL EROSION	333	1934	2806	31%
B-1070	5	5	FLUVIAL EROSION	583	259	258	0%
B-1070	6	6	FLUVIAL EROSION	41	315	1079	71%
B-1070	7		MASS MOVEMENT	0	56	56	0%
B-1070	8	7	FLUVIAL EROSION	0	392	1140	66%
			TOTALS:	984	3424	6054	43%

APPENDIX C: Glossary

Abandoned Road: A road is considered "abandoned" when there is no evidence of maintenance or current use.

Anadromous: Fish that leave freshwater and migrate to the ocean to mature then return to freshwater to spawn.

Bottom Flag: A survey flag which marks the bottom (BOT) of an excavation, at the lower extent of the fill slope at a stream crossing.

Cable Yarded: A modern type of power logging, where logs are attached to cables and dragged to a landing by means of a block-and-tackle, hung on a spar tree or steel tower or pole.

Channel Width: The estimated stream channel width during a 100-year flow event.

CLP: Refers to the "Centerline (of a) Profile". At stream crossings, this line is concurrent with the stream profile.

Complexity: Based upon the amount of large organic material within a road fill, &/or how much vegetation surrounds a work site; this refers to the difficulty of the work needed from heavy equipment.

Conglomerate: A sedimentary rock type, which is composed predominantly of cemented gravels.

Continental Shelf: A gently sloping, shallowly submerged platform of sediments that extends from the shoreline to the edge of the continental slope.

Continental Slope: The steeply sloping continental margin, which extends from the edge of the continental shelf down into the oceanic abyss.

Cracks: A crack is a break or split, usually without a complete separation of parts. These may be continuous or discontinuous, within a road reach.

Cross-road Drain: A ditch-like channel, excavated across a road fill prism, to drain a spring or seep. The fill material is not entirely excavated for an XRD.

Culvert: A transverse drain, usually a metal pipe set beneath the road surface, which drains water from the inside of the road to the outside of the road. Culverts are used to drain ditches, springs, and streams across the road alignment.

Cutbank: A steep embankment located immediately above a road bench, that was created during road construction.

CTH: Acronym for "Cut-to-Here." This is a reference point, usually located at the bottom of the fill.

Debris Slide: A slow to rapid slide, involving down-slope translation of relatively dry and predominantly unconsolidated materials, with more than half of the particles being larger than sand size.

Debris Torrent: Rapid movement of a large quantity of materials (wood and sediment) down a stream channel during storms or floods. This generally occurs in smaller, steep stream channels and results in scouring of the streambed.

Decommissioned Road: A road along which those elements that unnaturally reroute hill slope drainage, or present slope stability hazards, have been removed.

Deep Seated: A fill failure that cuts into most of the road prism, and takes natural ground along with it.

Disposal Site: A stable location for the stockpiling of fill removed from a work site.

Ditch Relief: A drainage structure or facility that will move water from an inside road ditch to an area outside of the edge of the road fill.
Diversion Potential (DP): If a drainage structure is plugged, or could possibly become plugged, diverting water down a road and away from its natural channel, the stream is considered to have "diversion potential."
Drivable: A road that is passable to a standard four-wheel drive vehicle without having to clear any brush or make improvements.
DS: Acronym for "Disposal Site."
Earth-flow: A mass movement landform, and slow to rapid mass movement process, characterized by down-slope translation of soil and weathered rock, over a discreet shear zone at the base. Most of the included particles are actually smaller than sand.
EOS: Acronym for "Export Outslope."
Erosion Potential: This is the likelihood of a stream crossing or landslide to erode away road/slope material.
Excavation Production Rate: The rate of production at which dirt can be moved at a particular site, by a particular type of equipment.
Export Outslope: In areas where a road prism is composed entirely of unstable fill material (i.e., no dozer cut road bench) complete exportation to a stable storage location becomes necessary.
Fault: A fracture or zone of fractures within the Earth's crust, along which there has been
relative movement and resultant shearing.
Faulting the oppositional movement of 2 blocks of the Earth's crust, along a fracture.
Fill: The material that is placed in low areas, compacted, and built up to form a roadbed or landing surface.
Fill Failure: Unstable fill, along the outside edge of a road, which is considered active or waiting to move down-slope.
Fluvial: Anything pertaining to streams or rivers; also organisms that migrate between main rivers and tributaries.
Fluvial Erosion Site: Fluvial erosion sites are places where erosion by the action of water is likely, as at a stream crossing.
Future Fill Failure: The estimated volume of a mass movement along a road bench or landing, caused by gravitational erosion &/or diversion of water, and measured in cubic yards.
Future Hill Slope Failure: The estimated volume of a mass movement upon a hill slope, which is related to gravitational erosion &/or diversion of water. Generally based on observed dimensions of existing hill slope failures, in nearby terrain, that have similar characteristics (e.g., slope position, geology, etc.).
Future Stream Erosion: The predicted volume of bank and/or bed erosion and streamside landslides, attributable to diversion at a crossing, and measured in cubic yards.
Future Percent Delivery to a Channel: The percentage of a volume of mass movement material reported in the field, that will be transported to a stream channel.
Geomorphic Investigations: The overall study of a landscape and its drainage features.

Geomorphic Mapping: The mapping of drainage patterns along roads and their surrounding slopes.
Gully: An erosional channel that is formed by concentrated surface runoff, which is defined as larger than 1 ft.^{2} in cross sectional area (i.e., 1 ft. depth by 1 ft. width). Gullies often form where road surface or ditch runoff is directed onto unprotected slopes.
Headwall Height: Headwall height is measured in inches, from the bottom of a culvert inlet, to the lowest point of the road fill at a crossing. This is the vertical distance between the point where water can enter a culvert and where water will flow over a road bench. Headwall height is used to assess the culvert capacity for each site.
Humboldt: A road-crossing drainage structure made out of logs laid in (and parallel to) streams channel and then covered over with road fill.
Hydrologic Decommissioning: The removal of those elements that unnaturally reroute hill slope drainage, or present slope stability hazards.
IBD: Acronym for "Inboard Ditch," which generally runs along the IBR.
IBR: Acronym for "Inboard (edge of) Road" commonly located below a cutbank.
Igneous: Rocks formed by solidification of hot fluid material termed magma.
Inner Gorge: A stream reach bounded by steep valley walls that terminate up slope into a more gentle topography. Common in areas of rapid stream down-cutting &/or geologic uplift.
Landing: Any place on or adjacent to a logging site (usually on a road), where logs are collected and assembled for further transport.
LEC: Acronym for "Left Edge of Cut:" refers to a field estimate (in feet) to the point at which the top of an excavation would extend to the left side of a CLP.
LES: Acronym for "Lower End Stake:" refers to the lowest ending point of a profile. This point is always shot downhill from the bottom of the fill.
Maintained: If a road shows evidence of recent maintenance, including grading, cleaning of culvert inlets, brushing, or upgrading, it is considered to be "maintained."
Mass Movement Site: Mass movement sites are places where failure of a hillside or road prism (by land sliding) is likely.
Metamorphic: All rocks that have changed form (from their sedimentary or igneous origin) due to the effects of high pressure/temperature &/or associated changes in chemistry.
Natural Ground: Undisturbed native soil.
Photo Number: The frame number (along a flight line) of an aerial photograph.
Plug Potential: The likelihood for sediment or woody to plug a culvert inlet. Example: If a pipe is already partially filled with sediment, its gradient is substantially less than the natural channel, &/or if the upstream channel contains large amounts of organic material likely to move at high flows, a culvert is considered to have plug potential.
OBF: Acronym for "Outer Board (edge of the) Fill" slope, which extends beyond the OBR.
OBR: Acronym for "Outboard Edge (of a) Road."
Primary-Line: A surveyed line used to identify the locations/relationships of sites along a road and/or its strip map.
REC: Acronym for the "Right Edge of Cut": refers to the field estimate (in feet) to where the top of an excavation would extend to the right side of the CLP of a road.

Rill: An erosional channel, varying in size from a rivulet up to about 1 ft.^{2} in cross section, that typically forms where rainfall and surface runoff is concentrated on fill slopes, cut-banks, and ditches. If the channel is larger than 1sq.ft. in size, this becomes a "gully."
Road Name: The name assigned to a road along which a potential erosion site is located. If no road name is available, then the field person will improvise, using conventional methods.
Road Reach: A stretch of road (excluding landings and/or stream crossings) which has been prescribed for a single treatment.
Rolling Dip: Rolling dips are broad, low road structures constructed to facilitate effective water drainage, while allowing passage of motor vehicles at a reduced road speed.
Rolling Outslope: An outsloped road receives a series "rolling dips" to accommodate multiple wet areas (i.e., springs/seeps)
ROS: Acronym for "Rolling Outslope."
Scarps: Cracks that show vertical displacement. These may be discontinuous and/or continuous within a road reach.
Sedimentary: Descriptive term for rock formed from sediment.
Seep: Wet areas of ground seepage; distinguishable from springs by lack of visible flow.
Shale: A sedimentary rock type that is composed predominantly of mud (a mixture of clay and silt), and which characteristically breaks into plates.
Shotgun: A pipe outlet that is elevated above the natural channel, and with no form of down spout. This time of outlet creates an erosional plunge basin.
Site: A numbered road locality that is considered to host erosional problems. Sites are numbered sequentially from one end of a road to the other.
Skid Trail: Generally a short, wide road-like trail over which tractors have dragged logs that were attached to cables.
Slope Stabilization: The removal of any and all features that may lead to slope instability and mass wasting.
Spring: A flow of water from the ground; often the source of a stream or pond.
Stream Channel Morphology: The various forms and shapes of a stream channel.
Stream Crossing: The location where a road crosses a stream channel, whether water is flowing or not. Drainage structures used in stream crossings include bridges, Humboldts, fords, culverts, and a variety of temporary crossings.
Swale: A channel-like linear depression, or small valley-like feature, that may, or may not contain any well-developed stream flow.
Top Flag: A survey flag hung at the top of an excavation site. This marks the upper limit that the excavation will extend to, and usually coincides with the upper extent of a stream crossing (including any stored sediment above a culvert inlet).
Total Fill Volume: The total volume of road fill at a potential erosion site, measured in cubic yards. At a stream crossing, this volume includes all road fill placed within the natural channel. Total fill volume is computed from field measurements made with a tape and clinometer (or Abney level). The computation requires measurements of slope angles and distance on upstream and downstream fill slopes, the width of the road

surface, and the valley width at the upstream and downstream edges of the road surface. Volumes are generally computed from field measurements using scale drawings prepared in the office.

Total Volume Excavated: The amount, in cubic yards, to be excavated at a site.

Tractor Logged: A logging operation where cable-attached skidding is done with crawler tractor power.

Treatment Immediacy: The urgency of implementation of hydrologic decommissioning at a site.

Tribal Allotment: Trust lands granted by the Federal Government to individuals/families with a long-established history of occupation/ownership.

UES: Acronym for "Upper End Stake:" refers to the upper starting point of a profile line.

Underfit: Any drainage structure (e.g. a culvert, swale, floodplain, etc.) that is too small to accommodate runoff during a flood..

USGS: Abbreviation for the United States Geological Survey.

Watershed: The entire area that contributes both surface and underground water to a particular lake, river, or stream system.

XRD: Abbreviation for "Cross-Road Drain;" a ditch-like channel excavated across road fill to drain a spring or seep. The road fill prism is not entirely excavated for an XRD, as at a stream crossing.

Year of Construction: The year that a road was built. This information is usually extrapolated from historical air photo analysis.